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PAVING SEWERAGE

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SANITATION,
BRIDGES.

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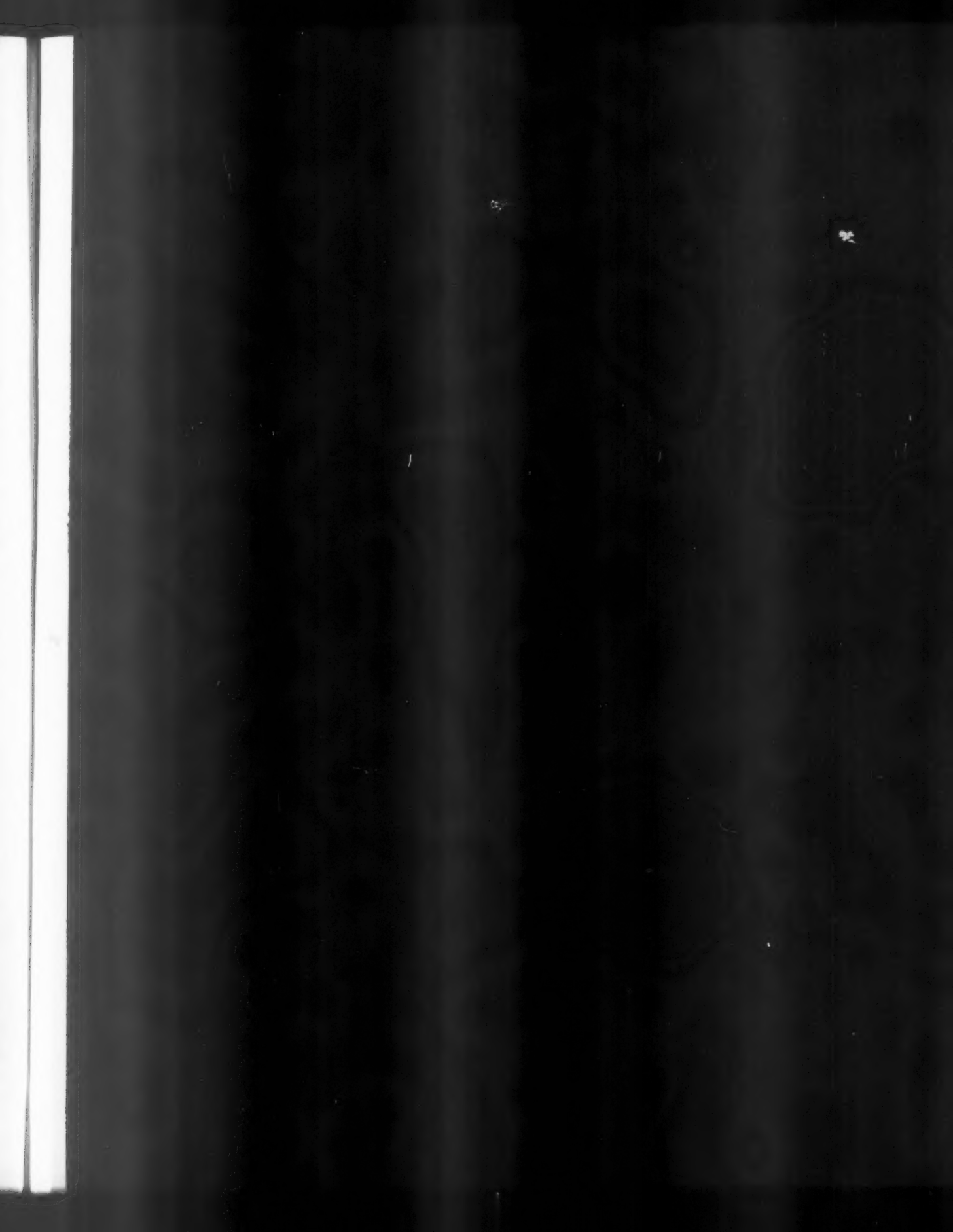
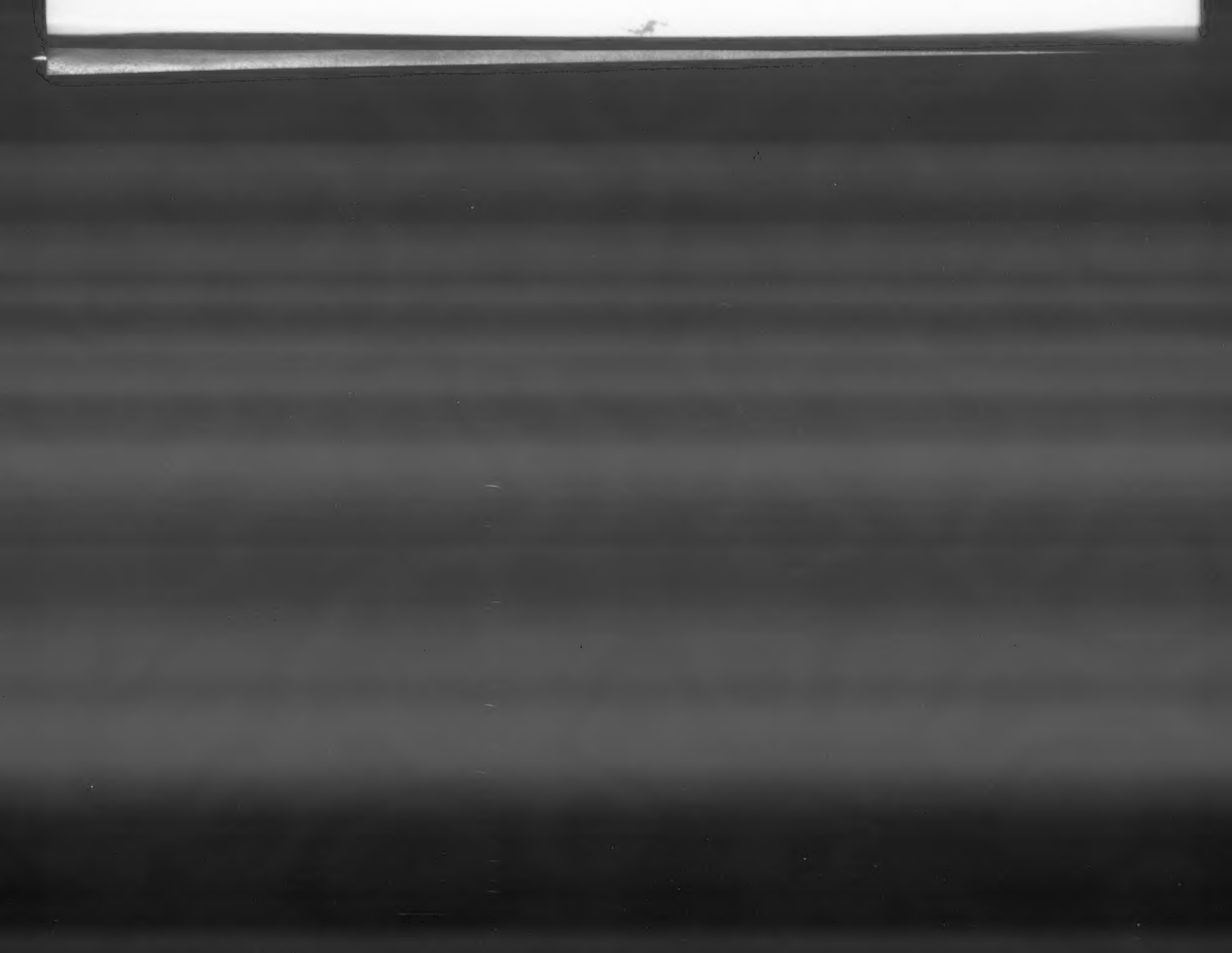




Municipal Engineering

VOLUME XII. MARCH, EIGHTEEN NINETY-SEVEN. NUMBER 3.

CROSS SECTIONS OF EUROPEAN STREETS.

By Robert Grimshaw, C. E.

Several things—as for instance centralization of government, the more ready submission of the people to be governed, a greater amount of local pride, an inheritance of good roadways from early days, a greater love of the beautiful, and the necessity for military purposes of having good streets—permit the enactment and enforcement, in Europe, of more strict laws than would be possible in America, concerning the laying out and maintenance of city streets as well as of national highways. The extraordinary growth in area and population of German cities, in particular,* is largely due to the increased facilities afforded, for reaching the business centers from the suburbs, and *vice versa*. City building, as a science and an art, is studied and taught, and in no particular more thoroughly than in reference to the streets, which are laid out, not merely with reference to expected growth, but with the idea of furthering growth and taking care of the thus fostered traffic when it comes.

This paper, from German sources, shows the usage and the provision made as regards street width and profile.

With reference to the minimum street-width of European cities: In Prussia the law of 1875 calls for minimum widths for cross-streets, long side streets, and principal streets, 12, 20 and 30 meters (39.4, 65.6 and 98.4 feet) respectively. The Hamburg regulations prescribe for streets with heavy traffic a width of 20 to 30 meters (65.6 to 98.4 feet), with a minimum width for any street for city or suburbs, of 17 m. (55.8 ft.). Only by special ordinance can even side streets be less than 8 m. (26.2 ft.). The Vienna building regulations de-

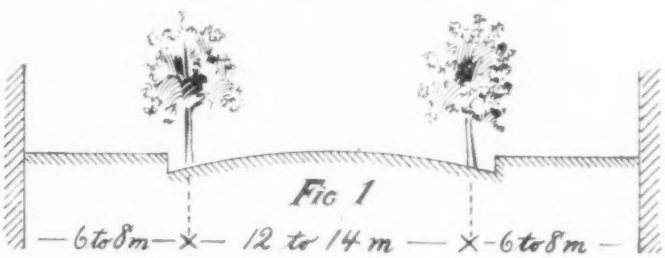


Fig 1

*A recent article in an American monthly magazine showed how the 60 principal German cities had outstripped the 60 American cities corresponding in 1880 in population. Berlin has grown more rapidly in numbers and in per cent. than Chicago, during the last decade.

mand that the distance between fronts in streets and alleys already laid out be at least 16 m. (52.5 ft.), but permits, in special cases 12 m. (39.4 ft.). For new streets the width must be 16 m. (52.5 ft.). In many cities the minimum is 15 m. (49.2 ft.), as for instance in Mainz (Mayence), Frankfurt, Strassburg, Nuermberg (Nuremberg), Magdeburg Halle, and Genf (Geneva).

It is now recognized that public health demands a proportion between the maximum height of the buildings in any street, and the width of that street, in order to give sufficient light and air. It is, however, generally considered sufficient to say that the height of the buildings should not be greater than the width of the street.

Fig. 2.

Another element to be considered with reference to the width of roadway and footway has recently come in: the gas and water pipes, sewers, street-railway cables, electric wires, etc. Attempts are made to lessen the frequency of tearing up the streets and if possible to avoid it. In Paris the immense sewer tunnels afford great help, carrying as they do two separate lines of water-pipes and a great mass of gas and other conduits. In London, tunnels have long been used for such purposes; these are supplied with frequent stairways for access, and with numerous openings for light and air; while cross-tunnels and pipes permit access to the buildings, for the gas and water service-pipes, etc. But by reason of the very general use of the room under the pavement, for cellars, coal-vaults, etc., this system has not found much favor in England generally; in fact many engineers consider their adoption, for reasons of public health and safety, and, because of their cost, hardly to be urged.

In Germany where such conduits have been proposed, the space under the footways has been chosen, as for instance in Hamburg, where the system is being tried. It may be said that there is a tendency toward burying all such pipes and wires, but that by reason of the complication of the problem itself, outside of the conflict of interests represented, nothing definite has been arrived at. It seems certain, however, that under the new regime the footways will be widened at the expense of the roadway between them. There appears also a disposition to limit the minimum distance between water-pipes and the house-line to 5 or 6 meters (16.4 to 19.7 ft.) by reason of danger to foundations in case of leaks or of bursts; and to necessitate at least a portion of the footway being porous, in order to permit the passage of gas which might otherwise get into the houses and cause explosions, ill health, or inconvenience. In furtherance of this last idea, flag and mosaic foot pavements must be laid in

sand; and where asphalt is used on trottoirs there must be a continuous strip of porous paving to let the gas through.

The intention to lay gas and water-pipes under the footways has been shown in Germany for some years in the larger cities, as for example in Frankfort-on-the-Main, and in Breslau. In Berlin the plans in this particular are already made; and also in some of the smaller cities (as Wiesbaden), the footways in new streets are given greater actual and proportional width than was formerly prescribed, in the latter cities, the footways having a united width nearly equal to that of the carriageway.

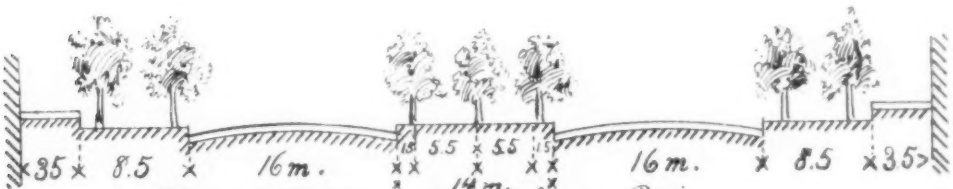


FIG. 3 — Boulevard des Italiens. Paris.

Hobrecht, one of the best authorities on this subject, says most decidedly that as it is now the custom to pave the carriage way well, especially in large cities, then the more thoroughly this is done the greater the necessity of laying the gas and water pipes, etc., under the footways; and mentions as an advantage the ensuing shortening of the house connections. This, says he, entails the necessity of greater width of trottoir, even when it calls for narrowing the carriage way beyond the usual permissible minimum. This, not only insures greater convenience for the future, but improves the appearance of the street as a whole. Finally, adds he, the foot traffic demands consideration which it seldom receives, while on the contrary the vehicle traffic is considered more than it needs or deserves. Vehicles must in large cities forego fast travel, and even passing each other. A large part of them, especially heavy drays and goods wagons go very slowly; and to permit the lighter vehicles and those carrying people only to pass them, the city is put to great expense in making and maintaining streets of unnecessary extra width. It is certainly very fine to see handsome equipages dashing through the streets at comparatively high speed instead of being compelled to keep in line and travel slowly; but that so great a number of streets should be made extra wide to permit this is not right. If all vehicles are compelled to keep in line and go at a specified pace, it is marvelous to see (and one need only refer to the Strand in London, for an example) how many vehicles can find accommodation in a narrow roadway. It is also noteworthy that with narrow streets and vehicles kept in line and at pace, there is greater safety for foot travelers who cross them than where there is greater width, and the possibility of vehicles dashing to and fro in the open spaces naturally brought out by pedestrians.

The usual rule in laying out streets is three strips: two for pedestrians and one for vehicles. But the effect which may be produced by a less simple disposition

of the road and footways, in combination with trees, flower-beds and grass-plats, is surprising.

In order merely to have two rows of trees in the street, the single carriage-way with foot way on each side is not only sufficient, but affords two methods of placing the trees: one as in Fig. 1, in which they are planted in the roadway, and the other as in Fig. 2, in which vehicles are given more room and the trees are better protected from injury. If, however, the rule is adhered to, that in order to give plenty of light and air to the houses, the trees should be not less than 6 to 8 meters = 19.7 to 26.2 feet, from the building line, and if the usual width of carriage-way is given, this calls for a total street width of 25 to 30 meters = 82 to 98.4 feet.

Fig. 4 — Ringstrasse. Vienne

Fig. 5 — Kaiserstrasse, Mainz.

It is certainly more in furtherance of the artistic appearance of the street as well as of the health of the occupants of the houses thereon, that the trees should be in a double row down the center with a footway between, but as that calls for a carriageway on each side we have a five-fold division of the street width. We have such an arrangement in more or less variation in the "swell" streets of the principal metropolitan cities under the name of ring streets, boulevards, avenues, alleys, etc. Fig. 3, 4 and 5 give three examples: the Boulevard des Italiens, Paris; the Ringstrasse, Vienna, and the Kaiserstrasse, Mainz (Mayence). The artistic effect is much increased where (as in Brussels, Ghent and other cities) a river or a canal lies along the center of width of the avenue.

The usual rules for street width and division call for no difference, whether the street be long or short; but where it is very long the rule may well be altered, and parts of it made wider than others, or divided differently.

As regards the outline of cross profile, the same general rules apply as for county roads, except that for city streets the footways are raised; a state of affairs permissible by the better gutters and the underground drainage. The footways naturally slope from the houses toward the center line of the street. Where there are several divisions of the street width, of course the slope of the trottoirs varies according to circumstances.

Only in small places are the footways of the same level as the carriageway, or the entire street width is paved for vehicle traffic, and in this case the entire street width slopes from both sides down toward the center.

According to Baumeister the following fall in cross profile is correct for various kinds of city streets:

Roadways, macadamized. 3 to 6 per cent.
" stone paved.. 2 to 4 per cent.
" brick or wood 1½ to 3 per cent.
" asphalt ..... ½ to 2 per cent.

The foregoing are for streets with medium lengthwise grade. Where this grade is steep, the cross-fall may be 1 to 2 per cent. less than for levels.

Footways, stone-paved ....3 to 4 per cent.
" impervious.....2 to 3 per cent.

As regards gutters: their minimum lengthwise fall is usually 1 per cent. unless they are asphalted, when it may be as little as ½ per cent. Where the street has less fall than this, the cross section must, of necessity, vary so as to allow this much; but the rule is not to permit the height of the footway and the carriageway to vary further than between 5 c. m. and 20 c. m. (2 and 8 inches).

As far as possible, the gutters are never so laid out as to necessitate the surface-water being led around a corner.

STANDARD TESTS AND SPECIFICATIONS FOR AMERICAN PORTLAND CEMENT. II.

By Frederick H. Lewis.

It is a fortunate thing for everybody that we have standard methods for physical tests of cement. The recommendations of the American Society of Civil Engineers on this subject for obvious reasons should be followed by all those engaged in laboratory work. This would be desirable even if the practice suggested were not of the best, but as a matter of fact the general lines laid down by the American Society are correct, and can not be materially improved. This is the general opinion of all those who have given most attention to the subject in this country. The trowel has proved to be both quicker and better for working and tempering cements than any mechanical device; the moulds are better in design than those used abroad; the testing speed agrees with European standards, and the machines for tensile tests of briquettes are on a par with European machines. Every laboratory then should have the following numbers of the Proceedings of the Am. Soc. C. E.: No. 276, March, 1884, and No. 315, November, 1885.

The requirements for tensile strength of briquettes should have due regard for the testing facilities which are available. The figures suggested by the American Society are quite sufficient for a laboratory set up for the occasion, or in which work is done only occasionally. With better facilities the figures may be even higher, but 500 lbs. neat at 7 days is quite a maximum for a first-class laboratory, and a little less is perhaps better. We have seen in recent years very high figures for neat tests at short periods and it has been claimed that such results represent unusual quality, or great improvement in manufacture. Such a view can be

accepted only on sufficient evidence, as the claim may be wholly specious. In a paper read by the writer in December, 1894, before the Engineers' Club of Philadelphia, certain experimental tests were reported which showed that high tests are entirely at the command of manufacturers, and that such results may be no evidence whatever of quality. Thus the following experiments may be quoted:

Tests of an English Portland Cement.

Tests at 7 days, neat.

As sampled..... 502 pounds.
With 1 per cent. sulphate of lime added ..... 810 pounds.
or a gain of 60 per cent. by addition of sulphate.

Another English Portland Cement:

As sampled..... 528 pounds.
With 1½ per cent. sulphate of lime added..... ..... 787 pounds.
or a gain by addition of sulphate of 45 per cent.

As a matter of fact it is much more important to look sharply to the quality and condition of the cement offered than to rule too closely on tensile tests, especially if the operator is inexperienced. Tests for setting time, fineness tests, pats in air and cold water, and specific gravity tests can be properly made by any one after a little practice and afford much better evidence of quality than would be shown by small variations in tensile strength.

Quite a number of specifications give figures for tensile tests at 28 days and some even give figures up to three months, six months and a year. As a matter of fact it is of course impracticable to hold cement for testing longer than twenty-eight days, and desirable to limit the testing period to seven days. In this connection it is well to recall the fact that the tensile test of cement is a purely conventional test, designed for use at short periods. In construction, cement is not subjected to tensile strains and its strength in tension is not really the point to be determined. It was found, however, that compression tests at short periods gave irregular results due to slight irregularities in the specimens, while tensile test specimens were readily made, readily fitted to testing machines, and gave comparable results. The tensile test was accordingly adopted, with a special view to its advantages in tests at short periods. It seems desirable to call attention to this fact so that too much attention will not be given to tensile tests at long periods, as requirements for the reception of cements. If it is found desirable to get results at two periods to show the gain in strength, the English practice to test at three and at seven days may be adopted, dismissing the long time tests for purely experimental purposes. In this connection it is perhaps worth while to note that a fall in tensile strength at periods of six months and a year is frequently noted in perfectly good cements; figures to this effect appear frequently in records of foreign tests, and quite a number have been noted in the writer's experience. The fact is that the tensile test does not apply to these long periods and that the crushing test is then a much better test for cement. The reason of this is found in the well-known fact of crystallization, viz.: that minerals in crystallizing develop crystals which are hard but at the same time develop lines of cleavage between them; the crystals are hard but their union is weak. This is what has taken place when cement shows a continual increase in crushing strength but a falling off in tensile strength at long periods.

Fineness determinations are always in order and finely ground

cement is a good thing. There is no occasion, however, for going to extremes in this matter and making the fineness too high—87.5 per cent. through the No. 100 sieve, and 97.5 per cent. through the No. 50 sieve are quite high enough for all ordinary work.

The determination of specific gravity can readily and quickly be made either by the apparatus known as Candlot's specific gravity apparatus, or by LeChatelier's apparatus. The requirement of specific gravity should be a minimum of 3.05. Anything below this would indicate that the cement is stale and has taken up considerable carbonic acid and water or that it was not hard burnt in the kilns. It may also be due to adulteration with ground limestone, or any other mineral substance added at reduced cost.

HOT BATH TESTS.

No question has occupied more attention in recent literature than the boiling test, which has had very strong advocates in Europe and several in this country, notably Mr. W. W. Maclay, member Am. Soc. C. E., but it has not yet been adopted as a standard requirement in any European country. The results are largely dependent upon the conditions of the tests and it has not yet been demonstrated that the failure to pass the tests is necessarily due to any defect in the cement. The boiling apparatus for purposes of experiment should be an adjunct to every laboratory which can afford to have one, but in this respect it should be placed practically on a par with the extreme tests used in Germany, such as the Bunsen burner test, the oven test and the kiln test, all of which require large experience to conduct them properly and great judgment to interpret satisfactorily. These tests belong properly to the field of research and are not tests suitable for the reception of materials.

The test suggested by the late Mr. Faija, of London, of placing fresh pats over a bath of water at a temperature of 115° F., and immersing them after hard set, is quite a different thing from the boiling test and might very well be made in America, where our summer temperatures approach the figure suggested. The writer has found valuable indications from immersing perfectly fresh pats in cold water. This also may be reckoned a practical condition, and evidently cement should stand this test with little warping or cracking. In conducting this test it is important to work the cement to a thoroughly plastic condition, making the pats quite flat and low, so there will be no tendency of the fresh cement to flow laterally from its own weight when water-soaked.

CHEMICAL ANALYSES.

Chemical analysis of cement offered for use is a desirable feature of specifications for every important work. It is entirely practicable in every such specification to provide for filling by the contractor of lists of cements offered with records of tests and analyses, and for the engineer's privilege (or the architect's) to discard any whose records are not considered satisfactory. It may be objected that cement should rest on its merits as shown by tests and not on its brand. This is quite true to a certain extent, but cement making is a difficult art and testing is not infallible. Hence the propriety on all large work of discarding those cements with poor records. There is no use of inviting trouble

or in permitting the delivery for important work of a product which may not have yet passed the experimental stage. It is also practicable in many cases to provide for regular analyses for magnesia and sulphuric acid by reliable chemists not connected with manufacturing, and for occasional complete analyses.

If reliable analyses can be had, then the writer would favor requirements for sulphuric acid and magnesia, provided the writer of the specifications has clear views and convictions on these points. Sulphuric acid is readily dealt with; it need not exceed 1¼ per cent. in quick setting cements, with preferably less for sea water work, and for slow setting cements it should not much exceed 2 per cent. Magnesia is a much more difficult subject, and the fact is that no good opinion is now available which satisfactorily deals with the problems presented. The view has been that magnesia produced the same effect as free lime, but acted more slowly. This has latterly been denied, and the whole question reopened to discussion. Probably the other elements of composition have a good deal to do with the action of magnesia, and the condition of burning also has some effect upon the result. In conjunction with high lime or high sulphuric acid, the objection to magnesia would appear to be well founded for the reason that caustic magnesia and sulphate of magnesia both have very bad records, and seem likely to be present respectively under the conditions named. It must be admitted, however, that the proof is lacking, and it will necessarily take some years of experimenting to reach a demonstration.

The facts of present practice are shown fully in the table of cement analyses given later in this paper. The English and Belgium cements have generally low magnesia. In France, magnesia is not tolerated in Portland cement above three per cent. The German Association of Manufacturers in this book, "Der Portland Cement" (Berlin, 1892), reports the magnesia to vary in their products from a trace to 2.89 per cent. and adds: "How high magnesia may be without showing bad effects is not yet clearly understood, but, with our present information, should at the utmost be but little over three per cent." A committee of the German association is now studying magnesia and is expected to report in 1898.

The table which follows gives a large number of analyses which have been taken from various sources, those of the American cement having all been made by Messrs. Booth, Garrett and Blair of Philadelphia. In addition to giving the composition, the tables give for each cement the hydraulic index ratio suggested by Vicat (that is the ratio of silica plus alumina to lime plus magnesia), and LeChatelier's ratio (which represents by chemical equivalents the proportions of lime plus magnesia to silica plus alumina). These ratios have been calculated by the writer. The hydraulic index is considered normal when between the limits of 44 and 50, and LeChatelier's ratio to be normal when the figures do not exceed 2.7. These ratios are not to be considered to definitely settle the quality of a cement since there is also iron present which may combine with the lime, and sulphuric acid which also may combine with it, reducing the probable amount of free lime present, but neither doing much good. When the figures fall below 44 in hydraulic index, or above 2.7 in LeChatelier's ratio, they indicate that greater care must have been

used in manufacture, or else that the cement is not properly proportioned. In either case more care in testing is evidently required. The writer recommends a calculation of these ratios for all analyses as a basis for judging the character of cements.

SPECIFICATIONS.

In writing specifications it is always well to carefully consider the work in view, and to specify the grades of cement which the best information available indicates to be suitable for the circumstances. It is not to be expected that cement which is satisfactory for salt water work will be equally desirable for the wearing surface of a pavement, for concrete in the foundation of a great building, or for mortar in laying up brick masonry. Neither is it necessary to conclude that a cement which is unsatisfactory for one purpose may not be good for another. Nearly all contract work would be benefited by the use of two grades of cement, one quick setting and the other slow, for different parts of the work.

In what has preceded, the writer has endeavored to show the lines on which work in cement may progress. With all who are interested in the subject, let there be an open-minded attitude interested in the development of better practice in the use of cement, and in the development of better laboratory facilities and work. The establishment of laboratories of research, either in the colleges or by the general government, as has been done at Watertown, for physical tests, can only be beneficial to every one. We have only to follow these lines, manufacturers and consumers doing their part, and in a few years we shall place ourselves on an even footing in this specialty with European manufacture and practice, and on a par in this regard with the work which has been done here in other lines of engineering.

AMERICAN PORTLAND CEMENTS, ANALYSES BY BOOTH, GARRETT & BLAIR.

SiO_2	Al_2O_3	CaO	MgO	SO_3	Hydraulic Index %.	LeChatelier's Ratio.
22.96	9.38	60.88	1.87	0.94	50.	2.4
22.30	8.06	60.44	2.92	.....	48.	2.6
22.62	8.76	61.46	2.92	1.52	49.	2.5
21.96	8.29	60.52	3.43	1.49	47.	2.6
19.92	9.83	60.32	3.12	1.13	47.	2.7
22.68	6.71	62.30	3.41	1.88	46.	2.7
21.08	7.86	63.68	2.68	1.25	44.	2.8

FRENCH CEMENTS, FIGURES FROM CANDLOT'S "CHAUX ET CIMENTS HYDRAULIQUES." HYDRAULIC INDEX AND LECHATELIER'S RATIO. CALCULATED BY FREDERICK H. LEWIS.

SiO_2	Al_2O_3	CaO	MgO	SO_3	Hydraulic Index %.	LeChatelier's Ratio.
22.20	6.72	67.31	0.95	0.26	42.	2.8
23.50	7.75	64.07	0.58	0.60	48.	2.5
21.70	7.48	65.54	0.90	0.77	44.	2.8
23.40	7.36	63.70	0.95	1.02	48.	2.6
24.50	7.09	62.40	0.85	0.70	50.	2.4
25.40	6.65	61.60	1.08	0.84	51.	2.3
24.25	5.20	63.61	0.79	0.68	46.	2.6
22.30	8.04	58.68	2.20	2.23	50.	2.6
23.25	7.44	62.55	0.92	1.06	48.	2.5
23.00	8.33	60.90	1.10	1.40	51.	2.4
24.60	7.98	59.10	1.25	1.05	54.	2.2

ENGLISH CEMENTS. FIGURES FROM CANDLOT'S "CHAUX ET CIMENTS HYDRAULIQUES" — HYDRAULIC INDEX AND LECHATELIER'S RATIO. CALCULATED BY FREDERICK H. LEWIS.

SiO_2	Al_2O_3	CaO	MgO	SO_3	Hydraulic Index %.	LeChatelier's Ratio.
23.15	7.83	61.40	1.07	1.47	50.	2.4
23.30	7.65	62.20	1.04	1.06	49.	2.5
23.15	7.88	61.30	0.33	1.10	50.	2.4
23.70	7.80	59.36	0.55	1.25	52.	2.3
22.25	8.22	60.48	1.00	1.85	50.	2.4
21.95	7.99	59.08	1.04	1.52	50.	2.5
21.60	6.30	62.72	0.98	1.02	44.	2.7
21.35	7.15	62.16	0.95	1.06	45.	2.7
20.30	8.63	59.92	1.06	1.45	47.	2.6
23.30	8.13	60.48	0.60	1.20	51.	2.4
23.60	9.73	59.76	0.60	0.68	55.	2.2
24.05	8.69	59.69	0.90	1.47	54.	2.3
23.30	8.43	59.64	0.97	1.78	52.	2.5

GERMAN CEMENTS. FIGURES FROM CANDLOT'S "CHAUX ET CIMENTS HYDRAULIQUES." HYDRAULIC INDEX AND LECHATELIER'S RATIO. CALCULATED BY FREDERICK H. LEWIS.

SiO_2	Al_2O_3	CaO	MgO	SO_3	Hydraulic Index %.	LeChatelier's Ratio.
22.60	7.01	63.11	1.79	0.37	46.	2.6
21.75	8.16	63.39	2.30	0.51	46.	2.7
21.30	10.60	62.23	1.44	0.68	50.	2.5
24 85	6.07	64.40	1.26	0.51	47.	2.5
22.80	6.30	66.40	1.08	0.63	43.	2.8
23.70	5.25	67.18	1.00	1.40	43.	2.7
22.40	7.30	62.88	1.21	1.58	46.	2.6
22.80	7.46	63.28	1.24	0.98	47.	2.6
22.25	7.85	58.12	2.08	1.05	50.	2.4
20 80	8.66	62.52	1.68	0.89	49.	2.7
22.90	6.96	62.55	1.20	1.40	47.	2.6
23.20	7.40	61.82	1.15	1.33	49.	2.5
22.20	8.32	61.40	0 90	1.73	49.	2.5
21.00	8.23	62.10	1.08	1.47	46.	2.5

BELGIAN CEMENTS. FIGURES FROM CANDLOT'S "CHAUX ET CIMENTS HYDRAULIQUES." HYDRAULIC INDEX AND LECHATELIER'S RATIO. CALCULATED BY FREDERICK H. LEWIS.

SiO_2	Al_2O_3	CaO	MgO	SO_3	Hydraulic Index %.	LeChatelier's Ratio.
24.85	6.45	61.44	0.70	1.03	50.	2.3
24.50	8.51	60.03	0.88	1.54	54.	2.2
24.30	6.13	60.19	0.70	1.13	50.	2.4
23.80	6.39	62.32	0.72	1.17	48.	2.5
26.10	5.79	62.44	0.79	0.85	50.	2.3
24.30	5.33	64.12	0.72	0.74	46.	2.5

GERMAN CEMENTS. FIGURES FROM "DER PORTLAND CEMENT," HYDRAULIC INDEX AND LECHATELIER'S RATIO. CALCULATED BY FREDERICK H. LEWIS.

SiO_2	Al_2O_3	CaO	MgO	SO_3	Hydraulic Index %.	LeChatelier's Ratio.
22.58	6.52	62.02	1.13	1.15	46.	2.6
23.69	8.29	61.99	0.47	0.69	51.	2.4
22.80	7.70	62.89	1. 0	0.71	48.	2.6
22.59	5.56	63.59	1.30	1.13	44.	2.7
25 37	4.31	63.71	1.25	0.87	46.	2.5
23.33	7.12	63.79	1.49	....	47.	2.6
24.29	5.43	62.68	1.10	1.03	45.	2.6
19.80	6.78	63.27	2.02	1.08	41.	3.0
22.77	6.44	62.14	2.23	0.41	45.	2.6
22.85	5.51	65.59	1.24	1.09	43.	2.8
21.49	6.42	64.22	1.77	0.91	42.	2.8
21.90	6.60	64.70	1.10	0.80	43.	2.8
22.75	6.96	62.57	1.21	2.19	47.	2.6
22.60	6.91	61.99	1.09	1.13	47.	2.6
20.58	7.45	58.22	2.79	1.22	46.	2.7
20.78	7.73	62.32	...	....	....	....
19.83	6.75	64.98	1.94	0.19	40.	3.1
22.80	7.80	62.84	1.20	0.76	48.	2.5
21.97	7.47	63.51	1.02	0.98	46.	2.6
20.45	9.11	64.23	1.29	0.51	45.	2.7
22.90	5.20	64.80	1.20	1.47	43.	2.8
23.70	8.20	59.96	1.00	0.88	52.	2.3
21 80	6.85	65.36	1.78	....	43.	2.8
22.38	9.45	64.51	trace	1.44	49.	2.5
23.94	6.82	61.67	1.10	0.94	49.	2 4
24.76	7.71	62.66	1.04	....	51.	2.4
20.80	...	63.30	2.50	...	....	....
22.63	6.73.	61.19	0.68	0.87	48.	2 5
25.53	4. 6	58.53	2.10	1.44	48.	2.4
26.45	4. 7	64.18	trace	...	49.	2.4
22 24	8.30	62.05	0.91	0.36	49.	2.5
23.36	5.03	6 .50	1.67	0.60	42.	2.8
22.63	7.06	60.81	2.89	0.47	47.	2.6

TESTS OF NON-METALLIC WATER PIPES.

H. K. Landis, E. M.

Dr. B. Gosio, official health physician, has undertaken, under the direction of Professor Pagliani of the scientific laboratory of the department of public health of Rome, to determine the resistance to bursting, permeability, absorption, etc., of water pipes made of terra cotta or baked clay, stone and cement, the materials most used in Italy. The object of these tests was to ascertain, to what extent the liquids injurious to health would pass into or out of such pipes while in service, and thus determine their relative availability for various sanitary uses.

Resistance to internal pressure rarely exceeds 7 atmospheres. Terra cotta pipes 2 to 4 inches internal diameter, will withstand an internal pressure of 20 atmospheres, or about 300 pounds to the square inch. Stone has the least resistance, giving way under a pressure of 60 pounds to the square inch. Small pipes of cement 21 inches long, 1.36 inches inside diameter

and 1.56 inches in thickness, withstood a pressure of 7 atmospheres, although cracks which, however, caused no leaks, began to develop at 5 atmospheres pressure, especially when the stress was sustained. He states that for other sizes the resistance varies, without exception, inversely to the internal diameter. A terra cotta pipe 2¼ inches internal diameter will sustain 20 atmospheres while one 4½ inches diameter will bear but 6 atmospheres when of the same thickness. It is unfortunate that the experiments were not continued to show the ratio of this variation.

The author distinguishes between permeability and absorption; cement absorbs 9.5 per cent.; terra cotta, 7.80 per cent.; stone, 4.16 per cent.; nevertheless, in practice terra cotta is more permeable than cement. Absorption is measured by the ability to contain water for a long time after being saturated with it and exposed to the sun. Permeability is indicated by a small prolonged pressure, say of two atmospheres for eight days, and is measured by the quantity of liquid passing through the material. Terra cotta gives the greatest permeability, cement next, while stone is least permeable.

Experiments were also made to determine the quantity of water that would filter from the external soil into the pipes by hermetically sealing the small end of the pipe and placing it vertically in water and measuring the depth of water that would leak into it. At the end of seventy-two hours a glass rod covered with paper was dipped into the pipe and the depth of water observed on the wetted paper. Terra cotta let pass the most water. The other pipes let nothing pass until the air was exhausted, then it was found that cement still held its place between terra cotta and stone. He also insists on perfect joints and prefers a silicate of soda glaze, as lead glaze is liable to be attacked by the acids in waters from domestic uses.

PRIZE WATER-WORKS BLANKS AND RECORDS.

APPLICATIONS, PERMITS, RECORDS OF CONNECTIONS, ETC.

The prize competition announced by MUNICIPAL ENGINEERING during the latter part of 1896 for the best and most complete set of office blanks and accountant forms for the use of water-works companies attracted wide attention and called forth a great variety of forms, many of them being prepared especially for the occasion, and bearing evidences of considerable study. While the results aimed at by all were substantially the same, the methods of reaching these results are found to differ greatly. It is the purpose of MUNICIPAL ENGINEERING to sift from the mass of matter submitted the best examples in the different departments of work and lay them before its readers, as well as to point out how the best features of all may be so combined as to provide a method of keeping the accounts that is better than any one method now in use considered separately. In doing this the aim will be to reduce to a minimum the labor and annoyance incident to the care of a large number of small accounts by

adopting simple rather than complicated methods, by avoiding a duplication of entries wherever possible, by keeping forms in compact and convenient shape, and by omitting detailed records of non-essentials wherever it can be done. Conditions purely local in their character will, of course, suggest in some instances modifications to suit the particular requirements of individual cases.

Water-works plants in American cities are owned and operated in three different ways—by the municipality, by a syndicate controlling a number of plants through a main office, or by private individuals or corporations. The accountant systems are similar in many respects in all three cases, although in the case of municipal ownership there are some radical differences in some of the office record books from those necessary to a proper handling of the accounts under syndicate or private control. In treating the subject it is proposed to follow the lines of similarity as far as possible, calling attention to the points of divergence. The necessary changes to fit local needs will readily occur to the reader.

As an aid to a more systematic treatment of the matter the forms have been classified, and will be described in the following order under the groups into which they naturally fall:

1. Applications, permits, records of connections, etc.
2. Books of office record, including all permanent records of the above and succeeding classes, with receipts and expenditures.
3. Notices, bills, etc.
4. Engineer's and superintendent's reports and statements.
5. Miscellaneous.

The most important of these classes is the second, and it is here that there are found the greatest differences in methods in use. And it is in this class that there seems to be the greatest opportunity for improvement.

APPLICATIONS, PERMITS, ETC.

These blanks may follow the same lines, whether the plant is under municipal, syndicate or private control.

The Peoria Water Company, who received the first prize in the MUNICIPAL ENGINEERING competition, have eight different forms of application, according to the use to which the service is to be put: Water at flat rate, new or old service; meter rate, regular; meter rate, special; street sprinkling by wagon; special use (two forms); extension or alteration of connections, and service pipe alone, where water is not to be used at once. The forms are of the same general character, and one will serve as an example of them all. The one shown is 10 by 12 inches in size, being larger and covering more ground than those submitted by others. In contrast with this, one of the simplest forms submitted was that of the Denison Water Co., which reads:

DENISON, TEX.....189..

M. F. Fitzgerald, Sup't Denison Water Co.,

Please give a permit to.....

Plumbers, to tap water main on.....

street, to supply my premises, No .....

.....street.

No. of Rooms	No. Water Closets...
No. of Bath Tubs....	Metre .....

I agree to comply with all the rules of the Water Company, and pay metre bills promptly the first week in each month.

.....

After the application has been approved and a permit issued, the connection is made by the plumber, who files his report. The company's inspector makes examination, and if work is perfectly done certifies to that fact in writing, and water is turned on. The applicant is

then entered in the consumers' ledger devoted to patrons of his class, under name, street, street or lot number, and consecutive register number; and it is important that he may from that time on be readily located on the company's books whenever either his name or his street number is known. For this purpose many companies use a special form of index, each street being assigned to a page in alphabetical order, with the name at the head. It is ruled in parallel vertical columns. Alternate columns are filled in consecutive order, with house or lot numbers, and intervening ones are left vacant until connections are made, when in the vacant space corresponding to the lot number the register number is entered. When this is known it is a simple matter to locate the consumer. While this form of index is perhaps the simplest and best in general use, it is yet open to the objection to every form of index: that it is troublesome to maintain, and it is only used because it is considered a necessary sort of evil.

The Mattoon (Ill.) Clear Water Company submits a plan which simplifies many features of this branch of the work and dispenses entirely with the use of the index. It is a modification of the card index system. This system was originally devised as an index for libraries, but it possesses such flexibility and an adaptability to so wide a range of business requirements that it has rapidly come to be almost indispensable to the publisher, the banker, the insurance agent and others handling large numbers of small accounts, as well as the business or professional man of every sort who must have facts, figures or names ready for instant

APPLICATION FOR WATER.

BY METER ..... SERVICE

REGISTER NO. .....

Peoria, Ill. 189

To the Receiver of the Peoria Water Company:

I, being the owner of the premises hereinafter mentioned, hereby make application, subject to the Ordinance, to the Rules and Regulations of the Peoria Water Company, to future orders of the Court and amendments to the contract between the City of Peoria and the Water Company, with all of which I hereby agree to comply, for the water supply, at meter rates, from the Company's mains, for the premises

No. ..... Street .....

The following is a correct schedule of the premises, fixtures and uses for which the water supply is desired, which schedule also states all of the purposes for which water may be used on said premises

Buildings	*Faucets*	*Horses*	*Saloon Faucets* .....
.....	*Stationary Wash Tubs*	*Cows*	*Barber Shop, Chairs* .....
No. Rooms	*Faucets for Wash Tubs*	*Yard Hydrants*	*Bakery, Daily Bble* .....
Baths	*Slop Sinks*	*Street Washers*	*No. Persons Employed* .....
Water Closets	*Pantry Sinks*	*Sill Cocks*	*Boiler Capacity* ..... *H. P.*
Urinals	*Kitchen Sinks*	*Steam Heaters*	.....
Wash Basins	*Stable*	*Office Wash Basins*	.....

Rates hereunder to be payable monthly, at the office of the Peoria Water Company. The meter shall be furnished, located, set and maintained at my expense, to the satisfaction of the Company or its Receiver, and always accessible to its inspectors. I agree to hold the Peoria Water Company and the Receiver free from all liability for any and all damage resulting from the bursting or leaking of any pipe, boiler, heater, or other fixture of any kind whatever, located on said premises, or between the curb line and said premises.

I agree to give the Peoria Water Company written notice of any proposed changes in above schedule, and of any proposed additional uses of water on said premises.

I agree to continue such payments for ..... year ... and until further notice by me or by the Water Company, or its Receiver, at which time my right to water hereunder shall cease.

I agree that the service pipe between the curb line and the meter shall be satisfactory to the Receiver, and shall conform to and be maintained in accordance with the requirements of the Water Company, and that no acceptance of pipe other than extra strong lead, shall prejudice the right of the Receiver or the Water Company, at any time to require the substitution of extra strong lead pipe therefor.

I agree that if it shall appear that the meter is out of order, I will immediately send a written notice of the fact to the Superintendent at the Water Company's office, and that under no circumstances during the term of this contract will I permit said meter to be opened, tampered with or disconnected, except in the presence of a representative of the Water Company. I further agree that whenever, and as often as I shall be notified from the Water Company's office that the meter has been inspected and found to be out of order, or not to correctly register the water passing through the same, the meter shall, at my expense, be immediately repaired and adjusted, or a correct meter substituted therefor.

The Company may turn off the supply of water for any default on my part, but such act shall not release me from my obligation to pay as above provided, including the time the water may be so shut off.

The Company or its Receiver may terminate this contract and turn off the water for reasonable cause at any time during said period upon refunding the amount paid for any unexpired time. And upon the termination of this contract, or for any violation of the terms hereof, or for insufficient protection of meter against injury, or any unauthorized use of meter, or of the water herein applied for, the Peoria Water Company or its Receiver may immediately turn off the water from said premises.

Subject to inspection and approval by the Receiver.

Signature .....

Approved ..... *Receiver.*

Per ..... *Supt*

use when wanted. As the full capabilities of the system are not realized in the forms submitted by the Mattoon company they will not be published, but a form is given which more nearly covers the ground, the advantages of which are readily apparent.

No. 1. Application for Connection. (Buff.)

Street No.	Street		Name.
Reg. No.	App No.	Entered Reg. P.	Owner.

Application for Connection.

I hereby apply for a supply of water through a .....attachment for above described premises, and I agree that said water shall be used for the following purposes only, and in conformity with your rules and regulations, a copy of which I have read and understand. I agree to pay for such service at the following prices:

....
....
....
....

And should water be desired for any other purposes than herein set forth, I agree that before water is used for such other purpose I will make formal application for such privilege and pay the rate charged therefor, and should I ever desire a change of any kind in my water service pipes for further water privileges or convenience, before any such changes are made I agree to first make formal application to your Superintendent and obtain his permission for same.

.....
.....
.....

Signed .....

Date.....

Application approved: .....

.....

Date.....

(This card to be filed under street and number).

No. 2. Permit for Connection.

Name.		Street No.	Street.
Reg. No.	App.No.	Reg. P.	Owner.

Plumber's Permit. (Connection.)

Above named applicant is hereby granted permission to employ....., plumber, to.....the following fixtures to the water company's mains for use upon premises described.

....
....
....

All work to be done in accordance with the company's rules and regulations, and subject to the approval of its superintendent.

Signed.....

Date..... .....

(Plumber will fill out diagram and description upon the back and return this card to the water company promptly upon the completion of work.)

Inspector's Return.

Upon inspection I find that all of the above connections have been made, *and no more*. I have carefully examined the work and find it to be done in accordance with the regulations of the company, except as hereinafter set out, and I find the plumber's diagram upon the back hereof to be correct.

....
.....

Inspected ....189..
Water turned on..... ....189..
Size....; Make....; No... ; Meter....
.....*Inspector.*

(This card to be filed alphabetically, under applicant's surname.)

No. 3. Application for Change. (Pink.)

Street No.	Street.		Name.
Reg. No.	App. No.	Entered Reg. P.	Owner.

Application for Extension, Reduction or Alteration.

I hereby apply for permit to make the following ..... in service connections and fixtures upon above described premises:

.....
.....
.....

When such permit shall have been executed, I will then be chargeable with water for the following purposes only, which I agree to use for those purposes only and in conformity with your rules and regulations, and I agree to pay for such service at the following prices:

....
....
....
....

And I furthermore agree to abide by all the conditions of my original application now on file with your company, which application is hereby made a part of this agreement.

.....
.....

Signed .....

Date.....

Application approved.....

.....

Date.....

(This card to be filed in numerical order with original application.)

No. 4. Permit for Change.

Name.			Street No.	Street.
Reg. No.	App. No.	Reg. P.	Owner.	

Plumber's Permit. (*Alteration.*)

Above named applicant is hereby granted permission to employ ....., plumber, to make the following ..... in the connections and fixtures upon the above-described property:

.....

.....

.....

.....

All work to be done in accordance with the company's regulations and subject to the approval of its superintendent.

Signed .....

Date .....

(Plumber will fill out diagram and description upon the back and return this card to the water company promptly upon the completion of the work.)

Inspector's Return.

Upon inspection I find that all the above ..... have been made, and no more; I have carefully examined the work and find it to be done in accordance with the regulations of the company, except as hereinafter set out, and I find the plumber's diagram upon the back hereof to be correct.

.....

.....

.....

Inspected .....189..

Water turned on.....189..

.....*Inspector.*

(This card to be filed alphabetically, with original permit.)

No. 5. Plumber's Return.

Street. Arrow Points ?

.....

Street Line.

Property Line. Property Line.

The stop cock is located on the..... side of.....street .....feet .....(N., S., E. or W.) of..... division property line and.....feet from the street property line.

The following is a true statement of the connections made by me:

.....

.....

.....

.....

All fixtures are in good order. Water .....

Remarks.....

.....

.....Plumber.

.....189..

(To be printed on back of permit for connection and permit for alteration forms.)

These forms should be printed on cardboard of medium weight, Nos. 1–2 and 3–4, being originally connected by a perforated line, form No. 5 being printed upon the back of 2 and 4. As a distinguishing mark, 1 and 2 should be of a different color from 3 and 4. These cards contain in compact form the application, approval, permit, plumber's certificate, diagram, description of service and inspector's report, and are, when properly handled, self-indexing. After the cards have been filled out the permit is torn off and given the applicant, the application half being retained in the office. When connections have been made and inspection completed, and proper entries made in the consumers' ledger and other books of record, the cards should be filed edgewise in cases or drawers made for that purpose, so that the number or name may be readily seen in running through them without removing them from the case.

No. 1 is filed with reference first to street and then street number—that is, all numbers upon a given street are grouped, the numbers being arranged in consecutive order, and these groups in turn are arranged alphabetically. No. 2 is filed in a separate receptacle, in the same way except that it is filed alphabetically with reference to the applicant's name. In this way, if a street and number are known the name may be found by reference to application cards, and where the name is known the street and num-

ber may be ascertained from the permit cards. When any change or alteration is to be made the same course is followed, except that cards 3 and 4 are used, and they are filed *with the original ones*, the register number remaining the same. Thus the whole history of every case is kept where it may be seen when wanted, with little taxing of patience or loss of time, and without the necessity of handling large books made up chiefly of blank paper. There are several firms who manufacture the card index with some special features which increase its efficiency very materially. One of these features is a method of locking the cards in the case, where they may be referred to at any time, but are not readily taken out, thus diminishing the chances of their loss. Another feature is a guide card, a portion of which projects above the edge of the others, and upon this is written, where it will catch the eye quickly, the names of streets or numbers, or some other distinguishing signs to indicate the different groups or sections of cards.

It is evident that if distinct forms of blanks are desired for different classes of service, they may be used under this system, without in any way impairing its usefulness.

In succeeding issues, other forms will be given.

STANDARD SPECIFICATIONS FOR PAVING BRICK TESTS.

(Two years ago the National Brick Manufacturers' association appointed a committee to thoroughly investigate the testing of paving brick, with a view to the adoption by the association of standard specifications for conducting tests. Experimental work and study of the question has been in progress since, and a report was submitted to the National Brick Manufacturers' Association, at the annual meeting in Buffalo on February 4th, through the secretary of the committee, Prof. Edward Orton, Jr., as follows:)

A partial report of the work done by the commission was submitted to the association at the Atlanta convention and for that reason, no time will be occupied in restating the matters there brought forward, except in so far as may be necessary to connect the events into a satisfactory whole.

At the first meeting of the commission the whole subject of testing paving bricks was discussed, and it became evident to all the members that it was impossible to present a conclusive report on the subject until a considerable amount of careful investigation had been instituted. Therefore, the work of making these investigations was partitioned among the members of the commission and among the other gentlemen who met with us on invitation and who have acted as members of the commission since.

The amount of the work to be done, and the time required in making preparations for it, absolutely prevented a conclusion of the work of the commission at the date set in the resolution creating it, but at Atlanta the association extended the time till this date, and made suitable provision for the necessary expenses of the investigation.

At a recent meeting held in Indianapolis, the report of each member of the commission who had been assigned a portion of the work was heard, a brief resume of which is given below.

The tests which were designated for investigation, with a view to making use of them as a means of estimating the quality of brick for paving purposes, were: 1. Rattling, as a measure of toughness and wearing power. 2. Absorption, as a measure of vitrification and resistance to freezing. 3. Cross breaking, as a measure of structural perfection and freedom from defects due to manufacture. 4. Crushing, as a further indication of the same factors. 5. Hardness, as a confirmatory test of vitrification, and 6. Specific gravity, as a guide to the density and fineness of texture of the material.

The rattler test, in order to give comparable results, and to be sufficiently vigorous to give data of value and yet not so vigorous as to ruin any materials which might be put into it, before giving an opportunity to judge of their relative wear, required a very careful and systematic investigation.

Before beginning on this active work of testing, it was above all things necessary to obtain a standard sample of paving bricks, whose uniformity should be developed to the highest point attainable under actual manufacturing conditions.

The Canton Brick Company, Canton, O., very generously made offer of a car load of brick, to be selected from a kiln of their wares, on any terms I might dictate. The number required was chosen in a compact block from the heart of a kiln of pavers. Stripping off the two top courses, a block ten courses deep and fourteen courses long was removed—keeping five courses from the bag walls on either side, and seven courses from the wicket. There were sixteen courses underneath those chosen. All liability to air checking, soft burning, over burning, etc., would thus be reduced to a minimum.

These bricks were perfectly drawn and shipped to Columbus and stored as a permanent supply in the testing-rooms of the clayworking laboratory of the Ohio State University.

The rattler employed in most of the succeeding work was built to order for the University, according to the provisional specifications adopted at the first meeting of the commission. It was 28 inches in diameter and 61 inches long, with a movable diaphram, capable of adjustment backward and forward, making two chambers of variable length.

It was a regular polygon of fourteen sides, in cross section, and was strongly built of soft gray cast iron. It was driven by gear pinion with a ratio of 8½ to 1 and by a 16-inch pulley 6-inch face. A constant speed electric motor of 15 horse power furnished the power.

The first point to be ascertained was the quantity of material which would occasion the greatest loss by rattling. Inasmuch as all bricks and stones vary considerably in specific gravity, it is plain that volume would be the only fair basis of comparison. Hence, a series of charges were weighed out, whose aggregate bulk amounted respectively to 5, 10, 12½, 15, 17½, 20, 22½, 25, 30, 35 and 40 per cent. of the internal cubic contents of the rattler. These were rattled for 1,000 and 2,000 R. each, and then losses balanced.

The results show that a maximum loss occurs when 15 per cent. up to 22½ per cent. charges are used. Ten per cent. and 25 per cent. are slightly below this maximum, while 5 per cent. and 30 per cent. and above fall off rapidly in losses, due on the one hand to too little crowding and on the other hand to overcrowding and lack of room to fall.

The practical lesson from this investigation is that not less than 10 per cent. should be used for any test and that no gain can be had by employing charges of more than 15 per cent. in volume.

The point to demand attention was the effect of time on the rate of loss by rattling. How long shall a test be rattled? Does it make any difference on the rate of wear?

To settle this point, four charges, of 10, 12½, 15 and 20 per cent. volume respectively were rattled for periods of ten minutes, or 250 Rev. each and weighed; and then for other periods of ten minutes each until each charge had received in the aggregate eighty minutes rattling and eight weighings. The losses being tabulated, showed that the rate of wear was greater in the first ten minutes and less in regular order for each subsequent period.

But after forty minutes, or 1,000 Rev., the rate of wear was only slightly less each time, and was plainly due to real wear, while the earlier losses were just as plainly due to corners and edges being knocked off. The evidence shows that not less than 1,000 R. would give correct comparison, and also that a longer test of 1,500 or 2,000 R. would be better, as it would give the brittle bricks a chance to average up with the softer burnt tough bricks which lost only by wear and not by chipping; that the former suffer worst at first is certain, and that they suffer least at last is probable.

The next point to be proved was the effect of the length of the chamber used in rattling. If all rattlers used for brick testing were made for this purpose and of uniform size, this test would be unnecessary. But as a fact, the rattlers used in the past include every size, every length, every speed and every kind and quantity of charge. Hence, to get uniformity of results, all conditions which can affect the rate of wear must be made the subject of accurate specifications.

To test the effect of length, charges of 10, 15 and 20 per cent. were weighed out, and rattled in chambers whose diameter was always 28 inches, but whose length by means of the adjustable diaphragm was made 12, 18, 24, 30, 36, 42 and 48 inches respectively.

The tabulated results show that the rate of losses are practically the same for each volume of charge employed, and the fluctuations indicate no fixed tendency either up or down.

From this it is fair to conclude that the length of the chamber is of no importance.

if a standard volume of charge be employed in each case.

The next variable element to be considered was the diameter of the rattlers. Engineers have used in the past rattlers from 16 inches in diameter up to 36 or 48. It is hardly conceivable that results are the same in all these sizes.

Accordingly, the use of a series of rattlers of 16, 18, 20, 22, 24, 28 and 34 inches diameter was secured in various shops and foundries, and charges of equal per cent. of volume were used in each at a uniform speed for a uniform time. The results when tabulated show that the rate of loss increases, all other things being equal, with the diameter, up to 28 inches. Increase above that size showed no increased rate of loss.

It is to be further considered that the uses to which rattlers are ordinarily put divide them naturally into two classes; the small ones for light work, which vary from 12 to 20 or 22 inches in diameter, and large rattlers for heavy work, which vary from 26 to 48 inches. The intermediate size of 24 inches is a very rare one in the city of Columbus at least, and none could be found after a search extending over one hundred different machines. The tests made on that diameter were finally obtained from the St. Louis Testing Laboratory from bricks shipped there for that purpose.

Consequently, in order to make tests widely useful, a size must be selected which engineers can obtain easily, and this would necessitate the use of machines of large diameter (from 26 inches up) rather than the smaller sizes, which are, of course, much less vigorous in their effects.

Also, since larger sizes than 28 inches seem to fail to produce proportionately greater wear, and since larger sizes would of course demand the use of larger and larger quantities of bricks to fill them to a standard volume, it follows that no benefit can be obtained by using sizes above 28 or 30 inches.

The remaining condition affecting the use of the machine itself is that of varying speeds. The question to be determined is whether the duration of a test can be measured in time or in revolutions, where speeds are different or variable. In other words, is the loss per revolution the same for all speeds, or does it vary with each speed employed?

To determine this point charges of one volume were rattled successively in the same machine under exactly uniform conditions, excepting that of speed, which was varied from sixteen per minute up to forty-eight per minute, by changing the driving pulley of the rattler from smaller to larger sizes.

The charges were weighed after running 1,000 R. and 2,000 R. and also after forty minutes' running time, regardless of rate of revolution. The data on being worked out show clearly:

1. The losses per revolution are practically the same between 16 and 48 R. per minute, there being a very slight increase between low rates and high rates of speed.

2. That the losses on equal terms increase directly with the rate of revolution.

3. That between 24 and 36 R. per minute the rate of loss per revolution is practically uniform.

The work done to this point has shown very clearly the conditions as to machinery and operation which ought to prevail in making a standard test. To bring them clearly in order they are here summarized:

1. Not less than 10 per cent. nor more than 15 per cent. of the volume of the rattler need be filled with the cubic contents of the charge.

2. It must be rattled for not less than 1,000 and preferably for not less than 2,000 R.

3. The length of the chamber is immaterial.

4. The diameter of the chamber must be between 26 and 30 inches.

5. The speed of revolution between twenty-four and thirty-six revolutions per minute is immaterial if the test is terminated when the requisite number of revolutions has been made.

Armed with this knowledge, the commission could have made a report recommending the standard tests. In order, however to try in every possibly way to conserve the interests of the brickmakers, and to avoid recommending any tests which would require them to furnish unnecessarily large quantities of material for tests, the experimental work of the rattler test was greatly extended.

It is plain that if the volume of a charge must be maintained at a fixed quantity, and that rattlers of somewhat large size must be employed to make the tests, that a great deal of material is going to be required to fill them. If this is to be all brick, the question arises, whether it is possible to supply a standard brick for filling up the bulk of a charge and use a few only of the test brick which often must be shipped from a distance. Also the use of iron as a filling material has been proposed and also granite and other stones.

The first series of tests on this line of ar-

gument were to test the utility of iron as an abrasive or filling material.

Accordingly, charges of five bricks each were weighed out, and small foundry shot, no piece of which weighed above one and one-half pounds and most of which did not exceed eight ounces, was used to fill these charges up to a volume of 5, 10, 15, 20 and 25 per cent. The losses on rattling showed a slightly decreased rate as the charge increased in volume, but the losses of all charges were only very slight and insufficient to show the relative quality of the bricks.

Next, cast iron bricks, weighing about 7¼ pounds each, with rounded corners and edges were used as a filling material in eight similar charges, two of each volume. The losses incident to their use were very severe and irregular—so much so that no idea could be had of the relative wear of the bricks. Besides breaking the bricks, the cast iron broke the machines as well, and was discontinued for that reason.

Iron, therefore, in large or small pieces, gave very unsatisfactory results as a filling material where the volume was maintained in the charge and only a few bricks employed in each test. Brick and stone were, therefore, the only available materials.

In order to obtain a more definite knowledge of the regularity of loss, where all brick charges of one kind of brick were employed, 10 sets of charges each of 10 per cent. volume were rattled for 1,000 to 2,000 R. at speed of 30 R. per minute, in the 28x18 chamber.

The tabulated losses showed a variation of about 4½ per cent. from the lowest to the highest, or a variation of about 20 per cent. of the total average loss, 10 above and 10 below.

The average found in this test for 1,000 and 2,000 R. were accepted as the standard loss for this material under these conditions and were used on a basis of comparison in all further tests. Having thus established what the standard brick ought to lose when tested by itself, and within what limit variations might be expected, the next matter was to test the results of substitution of brick with stone filling materials.

Accordingly, a quantity of three typical stones, a limestone, a granite and a sandstone, were obtained, and pieces were broken and chipped into condition so that they each weighed substantially the same as the bricks and their general outline was a rectangular one, as similar to a brick as was possible.

Duplicate charges of 10 per cent. volume of each of these stones were rattled to ascertain their characteristic rate of wear. Then mixed charges, consisting of three bricks and the rest of the volume supplied with stone, were rattled in triplicate.

The results of this test were unexpected. The bricks did not show a regular behavior at all; but in a number of cases they lost less than when rattled, brick on brick.

But, inasmuch as the cost of fresh square blocks of stone, of approximately uniform weight would be in excess of that of vitrified brick, it is apparent that no economy would result from their use, even if the results were satisfactory, which they were not. To be able to effect a saving, therefore, we should have to use the stones repeatedly.

To test the effect of this action, charges composed of the bricks as before, with the balance of the volume made up of 10 per cent. with rounded granite blocks, which had previously been rattled for not less than 2,000 R. Seven such charges were tested, supplying a new block of granite when any of the old ones broke or wore down to less than 80 per cent. of the weight of one brick.

The results when marshaled into shape show again very unexpected figures.

The losses were not only very erratic and irregular, but they were also very much higher on the average than those obtained with brick on brick, or brick on rough stones. The natural explanation of this is that the rounded granite becomes smooth and slippery and rolls readily, thus causing freer motion to the bricks and heavier blows.

The unsuitability of stones, either rough or smooth, either on grounds of economy or for its reliability and regularity of action being proven, the only remaining point as to selection of a filling material which remained to be investigated was the use of a brick filler, to be kept in stock at the testing laboratory and used as occasion presented.

To get at the effect of various fillers of this sort, nine samples of paving bricks and blocks of various quality, and two samples of building material, ordinarily soft burnt, were used. Charges of these standard bricks each were weighed out and filled to the standard volume with each of the new material and rattled under standard conditions. This was repeated three times in most cases and the results tabulated.

The results are very unsatisfactory, so far as showing the method to be suitable is concerned. They show some facts of

which no adequate explanation has presented itself. But, they do show that even where bricks of the same weight and substantially the same rattling value are used, that the results are very fluctuating and uncertain and not in any way fit to be used as a standard method.

There remain a few considerations which have not yet been submitted to direct test. Among these are the effect of water on the rate of wear. In other words, would a dry brick wear better than a wet one, or vice versa?

Also, the effect of size has not been fully investigated, although we know that a large brick does not suffer so much as a small one. Its loss in ounces is approximately the same, but the percentage loss is less.

The following experiments and conclusions from the St. Louis Testing Laboratory, executed by F. F. Harrington and presented by him personally, were brought before the commission in regard to the rattler test.

Standard Brick. Five hundred brick from Purington Brick Company, Galesburgh, Ill., were selected for uniformity from one kiln and shipped to St. Louis.

Rattler. Diameter 24 inches, length 42 inches, provided with movable cross partition or diagram.

Experiment I. To find the effect of volume of charge. Results showed maximum loss at 15 per cent. volume; less at either 10 or 20 per cent.

Experiment II. Effect of length—by moving diaphragm and testing chambers from 12 to 59 inches. Results showed no difference due to length and only such variations above and below the average as variations in brick and process occasion.

Experiment III. Effect of speed. Charges of equal volume and in equal sized chambers were rattled at speeds from 20 to 40 R. per minute. The results showed first, that the loss per revolution was substantially the same at all speeds tested, with a tendency to higher losses with higher speeds. That losses per minute vary directly with the speed.

Experiment IV. In all the work recorded in the first three experiments, the rattling was done in stages, from 10 minutes, 25, 40, 60 and 80 minutes, and weighings made after each period. These losses were plotted in curves, calculating and plotting each loss as the gross loss from the beginning. This gave, of course, gradually ascending curves, the reverse of those in series II of the university tests.

These curves, conducted on other materials, have shown that each kind of brick shows a characteristic rate of wear, more or less rapid at first and decreasing more or less as the process continues. These curves, therefore, conducted on the plan inaugurated by Mr. Harrington become very important and delicate means of determining the nature of a brick, since they not only show its gross loss, but indicate what its tendencies will be when exposed to actual conditions.

Credit is due to Mr. Harrington as being the first to bring out and use this characteristic wear curve for paving brick.

Experiment V. Effect of cast iron as an abrasive or filling material. The blocks of iron weighed 6 pounds each. The bricks were five in number and 10 blocks were added and rattled, no reference being made to maintaining a definite percentage of volume. Results: The losses of the bricks were irregular and fluctuating, and no characteristic curves could be drawn. The iron was condemned as an abrasive.

Experiment VI. Granite was tested, by itself, and its characteristic curves determined. Five varieties were used, and the losses were found to vary after eighty minutes rattling by 33 per cent. of the highest and 50 per cent. of the lowest. Also, the granite in nearly all cases gave curves not comparing in regularity with those of bricks, as its coarser structure made its losses irregular. Stone was therefore abandoned.

Experiment VII. The size of the brick on its rate of wear was investigated. Half bricks and whole bricks were tested, showing less wear on the whole brick. Also, three sizes of brick, or rather three thicknesses of brick from the same bar of clay were tested. The bricks were 8x3¾ in cross section and 3½, 3 and 2½ respectively in thickness. The percentage losses were least on the heaviest brick and greatest on the lightest brick. This clearly indicates that it is not fair to compute the loss on a brick absolutely, without reference to its size, and that this ought to be computed on its surface rather than its cubic contents.

Experiment VIII. The effect of overburning and underburning was also tested, showing in every case that overburnt bricks and underburnt bricks lost more than normally burnt bricks.

The experimental work done at Columbus and St. Louis was done absolutely independently and without communication; and inasmuch as every experiment made by both observers has shown identically the same results, the conclusions of both are

certainly very greatly strengthened, and in fact can hardly be gainsaid.

The recommendations of Prof. Orton on the method of making the rattler test were then taken up, discussed, and amended, article by article, and finally accepted as a whole.

THE ABSORPTION TEST.

The absorption test, originally assigned to Willard Beehan, was never completed by him, owing to his unfortunate loss of health. It was taken up, however, by Prof. H. A. Wheeler first and later by Mr. Harrington and brought to a satisfacory conclusion.

The porosity of burnt clay wares is well known to be the best index of their degree of chemical combination or vitrification; and, as many instances of failure of bricks by freezing have occurred in the earlier stages of the paving brick industry, the test has been from the first a most important and serviceable one.

In order to understand the conditions under which uniformity of absorption can be reasonably expected, the following tests were instituted by Mr. Harrington:

Experiment I. To determine what treatment is necessary to get the bricks completely dry, a special oven, made of sheet iron and well insulated with asbestos was built. It contained 120 bricks at once and was heated by a Bunsen burner to a temperature ranging from 220 degrees to 240 degrees F.

Ten sets of bricks, each made by a different firm, were placed in the dryer, weighing them carefully to with one gram first and then withdrawing them for re-weighing at intervals of 6, 24, 48, 96 and 168 hours.

The results when tabulated and reduced to a diagram, show that the water which is always found in burnt bricks, due probably to absorption from the atmosphere, cannot be expelled with even approximate accuracy with less than forty-eight hours' exposure to a temperature above the boiling point of water. The water continues still to escape even to 168 hours, or one week, but in small amounts only after forty-eight hours have passed.

Experiment II. Similar tests were next instituted on bricks which had been soaked for twenty-four hours previously. And, as bricks are received by the laboratory for test which have been exposed to rain and frost, it is plain that this test is only a fair comparison with such cases.

Ten sets of bricks, two to a set, of different makes, were again dried, after soaking. Conclusions are drawn from this series identical with those of series I. Water continued to evaporate after a week's heating, and forty-eight hours sufficed to get rid of nearly all of it.

Experiment III. After having dried a series of bricks thoroughly, as indicated in the two preceding experiments, they were immersed in water, duplicates being taken in each case. They were weighed in one day, two days, three days, one week, two weeks, four, six, eight, twelve and twenty-four weeks. The results, when plotted on a curve diagram, show that the absorption of hard burnt bricks was low in each case, and also that it followed the same laws as regulate the drying of the bricks before soaking. While after nearly six months' soaking, the entire series was still absorbing water, still the great bulk of the water was taken away in every case in the first week and generally in the first two or three days.

Experiment IV. In order to discover whether the rate of absorption is materially changed by exposing the interior of a brick to the action of water, a series of tests composed of whole bricks, half bricks, bricks with both ends broken off leaving the middle section intact, and lastly small pieces from the center of bricks, obtained from the crushing or cross-breaking tents, were dried and cooked as before for a period of twenty-four weeks, with periodic weighings as before. The results of this exhaustive test clearly show:

1. That broken bricks always absorb more water than whole ones, for either long or short periods.

2. That small pieces of brick from the interior are only satisfied after soaking for eight weeks.

3. That small pieces absorb more proportionately than either half bricks of the same manufacture.

The results of this very admirable series of tests by Mr. Harrington show us the following points:

1. That to obtain accurate figures as to the absorption of any hard brick will require not less than four days' drying and eight weeks' soaking.

2. That only roughly approximate figures are obtained within time limits which would be short enough to make the figures useful for ordinary competitive tests of material for immediate use.

3. That only rattled bricks should be used for absorption test, as the absorption power of the brick in use is certainly increased by its chipping and grinding under traffic.

4. A careful series of tests on bricks of

the same sample sets was made by rattling and a close comparison of the tabulated and plotted data was made. No connection between losses by rattling and percentages of absorption could be determined to exist. Bricks of high absorption are just as likely to show a good rattling test as a bad one, inside the limit shown by this set of samples.

In the same connection, the results of a series of experiments made some time ago at the Ohio State University may be quoted.

A series of bodies was made, purposely varying them so as to secure a regular gradation of vitrification when burned at the same heat. These were burned and cooled, and after various physical measurements had been made, they were finally rattled in a small-sized ball mill. Their losses being duly recorded, they were soaked to complete satiation and their percentage of absorption determined. The results when plotted showed very beautifully that the loss by abrasion was inversely proportioned to the gain by absorption—those gaining the greatest weight by soaking also lost the greatest amount by abrasion.

The result is in direct accord with the well-known facts. Every paving brick maker knows that if his bricks are not hard burnt they will suffer not only by abrasion but by frost.

But the point which is to be drawn from Mr. Harrington's work, which will doubtless commend itself to all brick-makers and users, is that where bricks have been burnt hard enough to endure a satisfactory rattler test, it is certain that they will not absorb water enough to cause their damage by frost. And since the absorption test, as ordinarily executed in the past, has been ridiculously incomplete and inefficient, and must be very greatly extended in duration and preliminary drying to even approximate the facts, it seems that the value of the test is hardly likely to repay one for its proper execution.

[The following recommendations were then taken up and discussed, and finally adopted.]

CROSS-BREAKING.

The third subject to receive examination was that of structural strength.

The tests usually applied in the investigation of this subject are crossbreaking and crushing.

None of the regularly appointed members of the commission had access to an accurate testing machine of sufficient capacity to crush a whole brick. And in the opinion of the commission, it is essential that this most reliable sort. Hence no new work has been executed on this test, but a review of the data already in existence was made.

In regard to the crossbreaking test, Mr. Harrington, under the direction of Mr. M. L. Holman, the water commissioner of St. Louis, has made a most elaborate examination of the proper methods of crossbreaking to give consistent and proper results.

The machine used by Mr. Harirngton was a hydraulic press designed by Mr. Holman, which was made the subject of very careful calibration before its results were considered as bearing on the point in view.

It is too much to attempt to describe at this time, beyond stating that the pressure is applied from above by insensible stages, by a straight knife edge of rounded cross section, so that no cutting of the skin of the brick occurs at pressures necessary to break it. The lower knife edges which support the brick also were made the subject of special test, and were only finally determined after prolonged trials. The common, straight, sharp knife edges in use have an effect of concentrating strains on a brick which cause rupture along certain lines of stress and at lower pressures than the brick is really capable of sustaining when differently supported.

After getting the machine under complete control so that its action was well understood and its tendencies corrected, the crossbreaking of a large number of samples of brick was begun.

Each sample consisted of 10 bricks, and the average of these ten results was taken as being the structural strength of the material in question. Beside the average, the maxima and minima were noted for each set of ten.

After tabulation of these data, an attempt was made to find out the relation, if any, existing between the rattling tests and absorption tests of the same makes of bricks. No relationship could be found in either direction. Bricks of low structural strength often stood high rattling tests and vice versa. Also, brick of the same make varied very greatly between extremes, so that an average often failed to give confidence as being really a characteristic figure for the material.

Beyond question, crossbreaking tests, conducted as carefully on as good machinery as above described do indicate something of the structural strength of bricks. But also, bricks in actual use in street paving are almost never submitted to strains of this character, nor to that of crushing; and hence the data obtained, even if they were

shall be done in order to get results of the thought to be characteristic, would still fail to show fitness for this use.

HARDNESS AND SPECIFIC GRAVITY.

The next subject taken up for discussion was that of the tests of hardness and specific gravity.

Mr. Harington submitted data obtained from ten samples of paving bricks, showing a range in specific gravity from 2.19 up to 2.41, the majority falling between 2.25 and 2.35.

The hardness of even fairly well burned paving bricks has been proven to lie very close to 6 in Moh's scale (—— —— Feldspar), and it is not possible by any known process or treatment to enable them to attain a hardness of 7 (quartz), though they considerably exceed 6. The comparatively small range as measured in this scale (Moh's) and the impossibility at this time of suggesting or applying any other test for hardness makes the value of the test seem doubtful. If the hardness is much below 6, it can be detected as quickly and as surely by other means and by the color of the ware.

No attempt to obtain any clue to a relationship between specific gravity and rattling, or absorption, or crossbreaking has proven successful. The heavier bricks, as a rule, are the better bricks, but not always. In view of these facts the following resolution was passed:

Whereas, After careful consideration of all the data as to hardness and specific gravity accessible to the commission, no relationship between these qualities and those necessary for good paving brick can be shown to exist, therefore,

Resolved, That the commission recommends that these tests be abandoned as unnecessary.

The commission then listened to a report from Prof. Orton on the effect of the structure of paving materials on their power to withstand wear by impact or abrasion. The investigation of this matter had been authorized by the commission at its meeting in July, 1895, and the work had been begun soon after.

The importance and value of the results obtained were fully recognized, but in the judgment of the commission the subject lay outside of the strict limits of its scope. According to the resolution which created it, its work was to discuss and recommend a standard method of making paving brick tests and no authority is given to assign specific standards of quality or to recommend changes in the present systems of manufacture, even in the belief that they are furthering the cause of good paving.

For this reason, the commission refused to give the matter a place in its official report, while sanctioning the expenditure of any funds which had been used for this purpose and strongly recommending to the association that it should hear and take action on the matter when presented separately.

In the conclusion of its labors, the commission passed a resolution thanking the Canton Brick Company and the Purington Paving Brick Company for donations of paving brick, and Prof. H. A. Wheeler of the Missouri Geological Society, F. F. Harrington of the St. Louis Testing Laboratory, M. L. Holman, water commissioner of St. Louis, and Prof. J. B. Johnson of Washington University for valuable co-operation in the work.

The association concurred in the report of the commission.

THE WEARING POWER OF PAVING BRICK.*

By Prof. Edward Orton, Jr.

In 1892 it was my fortune to conduct a series of experiments on the general properties of paving brick for the Ohio Geological Survey. I say experiments, though that is hardly the proper term to apply to the work which I did. My investigation consisted at that time of obtaining samples, selected in each case by the manufacturer, from some forty-five paving brick plants in the limits of Ohio. These samples were assembled at Columbus and tested by abrasion, absorption and crushing. The samples being selected by the manufacturers and coming from plants which used clays of all descriptions, from the alluvial clays of the Ohio river up to the shales and fire clays of the coal measures of Ohio, naturally gave a very wide range of qualities owing to the great diversity of materials used. Not only

*Read before the National Brick Manufacturers' Association, Feb. 4, 1897.

did variations in character come from this cause but also from the differences in structure due to methods of manufacture and similar differences of vitrification due to varying conditions of burning and cooling.

Under these circumstances it was, of course, impossible to draw accurate conclusions as to the effect of any particular type of machine, and well nigh impossible to draw even broad conclusions as to one type against another type. A careful review of all the data obtained in making this test showed that side cut brick had a higher average in wearing power than end cut brick. Eliminating so far as the nature of the samples made it possible to do so, differences in machinery and kind of clay used, comparisons between shale end cut brick and shale side cut brick, showed a slight difference in favor of the latter.

Also the subject of repressing was considered in this same connection, and an attempt was made to find out the effect of repressing by gathering the general average of all repressed brick against all plain brick, and also in several specific instances comparisons were made between repressed brick and plain brick of the same manufacture. In this test the advantage seemed to lie with the repressed brick.

Prof. H. A. Wheeler of St. Louis has assured me that he has recently gone carefully over the data of my test, and while he was unwilling to believe the conclusions which I there deduced, he was still unable to dispute that all the evidence pointed that way. The unsatisfactory nature of this test, however, has left me ever since its completion with a desire to probe the matter to the bottom.

In July, 1895, the commission on paving brick test of the National Brick Manufacturers' Association authorized me to begin a series of tests looking toward the solution of this question. A very partial and incomplete verbal report was made at Atlanta in December, 1895. Since that time the work has been pushed along with what speed was possible and I have now ready the results of the first investigation of this sort in which the conditions of variations have been practically eliminated and in which a real comparison is possible.

The sample of clay which was used in making this structure test consisted of about ten tons of shale material which was ground by dry-pan, screened, and run into a pile on the floor. This material was then shoveled over several times so as to mix the earlier and later portions of the charge. When it was considered to be homogeneous it was then tempered into pug-mill and packed as fast as tempered into barrels, of which some sixty were filled. Three barrels of this standard sample of clay were sent to ten different manufacturing establishments, all of them makers of paving brick or manufacturers of paving brick machinery.

With the sample a specific set of directions was sent, asking each one to unpack the clay, retemper with as little water as possible, put it into their brick machinery, the nature of which was specific in each separate case, and make the whole amount into brick without admixture of any other clay material. The first third of the brick which came from the machinery were directed to be rejected and the samples for future work were selected from the middle and rear portions of the charge, hoping by this means to absolutely avoid inter-mixture with such clays as the machinery had been working previous to its use in this test. The bricks on issuing from the machine were then directed to be dried on floors without the aid of artificial heat, so that the greatest uniformity in drying could be attained. When dry the samples were packed in saw-dust and sent back to the factory which made the original sample of clay.

The execution of this work being intrusted to so many different men and under such a variety of working conditions, naturally took some time, but after some months the brick made by these different machines had been assembled at the original point. There they were marked and set in a kiln in a compact body, as nearly as possible in the same course and at the same distance from the wickets or fire holes, so that air checking or any imperfections of burning which one brick might happen to meet would probably be shared by the other portions of the series. The kiln was fired as usual and in due time its contents were drawn and the sample brick were then packed in boxes divided into two lots, part of them being sent to Mr. F. F. Harrington in St. Louis for testing by cross breaking and crushing, while the majority, or possibly four-fifths of the series, was forwarded to me.

After checking up the numbers and identification marks of these brick they were divided into charges of five each. Some of the makes of brick were represented by only a few samples, owing to misunderstandings on the part of the maker, while others were represented by forty or fifty brick. The standard charge of five test

brick was then made up in volume to 10 per cent. of the cubic contents of the rattler by addition of eight Canton standard paving brick, selected from my standard pile in the laboratory. The first series of charges was then subjected to the abrasion test, being weighed after both 1,000 and 2,000 revolutions at standard speed and in a standard barrel. When this series had been completed as many of the different makes as were represented by enough brick to make a second set of charges were then carried through in similar manner, using Canton standard brick to fill up whatever vacancy in the 10 per cent. volume was demanded. A third series of tests was then made, using the remnants of the different makes of test brick which were left, and in most cases so adjusting the charges that end-cut and side-cut brick made from the same kind of machine were pitted against each other in the same charge, and no Canton brick were required to fill up these charges to the required volume. After completing the abrasion test on all of the samples which were forwarded to me the results were collated.

A careful study of this table reveals some results which, I think, will be of great value to the paving brick industry, and which are doubtless as much of a surprise to many paving brick makers as they have been to me. The conclusions which have been described in the early portions of this paper, as drawn from the Ohio Survey test, are completely overthrown by the results of this series, and since in this series every condition of manufacture in which variation could exist has been rendered almost absolutely uniform, for not only was the clay perfectly homogeneous, but also the pugging was in most cases done by the same machine and the clay was used before drying out. The drying in natural air without heat was certainly nearly uniform. The burning and cooling were absolutely fair and impartial, and the testing, it goes without saying, was equally so. In fact, until all the results were collated no one had any idea as to what conclusions could be drawn from the test. The only element of variation which has been allowed to enter into the series was that which was purposely made irregular, being the kind of machine which was used in manufacturing the brick.

In a careful chart I have shown graphically the results of the study of the tabulated loss in the table above. The very marked superiority of end-cut brick over side-cut brick is a surprise to me, and the equally plain advantage of represing end-cut brick and the equally plain disadvantage of represing side-cut brick cannot be mistaken by the most casual observer.

Now that the facts are obtained it seems easy to account for this fact. In the first case the line of pressure is at right angles to the lines of structure or lamination of the brick, while in side-cut brick the line of flow of the particles and the line of pressure in the repressed die are parallel, consequently the slight change in volume which occurs in repressing operates toward condensing the laminations of the end-cut brick, while it operates toward opening up and increasing the laminations of the side-cut brick. It will be noted in this table and chart no names or no clews are given which will enable one manufacturer or brickmaker to compare his brick to the disadvantage of others who may have had material in the same test. Also, I can state that several of the more important machine manufacturers have bricks from both their side-cut and end-cut machinery represented in this series; hence, it cannot be claimed or believed by any fair-minded person that the results of this test are meant to in any way prejudice one class of machinery or one class of makers against another class. The whole object has been to ascertain the truth in a spirit of scientific inquiry, and the results are so conclusive and so strong that it would seem that this association ought to find real financial profit from the work done.

I should greatly like to return official thanks to the various gentlemen who have been most helpful to me in prosecuting this series of tests, but at their own request I refrain from mentioning any names in the hope that the series of results here presented will carry the more weight for this reason.

THE QUESTION DEPARTMENT.

[By J. W. Howard, B. L., C. E., for MUNICIPAL ENGINEERING.]

REPAIR OF ASPHALT PAVEMENTS BY CITY EMPLOYES.

Can you name any cities which do their own asphalt pavement repairing and have their own asphalt plant?

Jos. P. Phillips, C. E., Scranton, Pa.

Careful inquiry shows that no city of Europe or America owns an asphalt paving plant, the word plant meaning a factory, large or small, for preparing asphalt paving mixtures for sheet asphalt pavements or for asphalt blocks. These plants are owned by many companies and contractors. St. Louis leases some melting and mixing kettles, operated by hand, and is making some repairs with city employes. We are unable to state whether these repairs are successful or not, nor whether they are economical or not, because we are told that the cost of labor, materials and superintendence is not fully tabulated, nor do definite reports or plans seem to be kept showing whether or not the repairs are from time to time made over portions of streets previously repaired within a year or two by the same employes. Hand repairs of streets paved with asphalt should be avoided, because machinery is needed to produce a homogeneous mixture.

Asphalt mastic sidewalks are sometimes laid in Europe with success by city employes, but the mixtures are softer and the work easily done by hand.

THE CROWN OF A PAVEMENT.

I have seen several rules for finding the height of the center of a pavement above the gutters of an asphalt paved street. Can you give me a table or rule to use for different pavements?

——, *Asst. Engineer, Dept. Public Works.*

It is not possible to give a general rule to cover all cases of any one kind of pavement, much less all kinds. It is necessary to consider, among other things, the kind and quality of the pavement, the grade of the street, quantity and character of traffic, the climate of the city, and the degree of cleanliness expected of the department in charge of street cleaning. Upon streets with a steep grade, horses have difficulty in descending a hill, if, in addition to the slope, the center of the roadway slants too much towards each gutter. If rain is relied upon to flush the streets and thus assist in keeping them clean, the roadway, where the street is reasonably level, should have as much crown as is consistent with the use of vehicles, or the slipping of horses in icy weather. All pavements wear better if quickly drained. Water often stands in very slight depressions when the cross-section of a pavement is too flat. This water disintegrates the pavement, in addition to retaining filth and being disagreeable.

A good rule for asphalt, granite and brick pavement crowns, when the surface of the pavement in each gutter is at the same height, or approximately upon the same horizontal line, is to make the center of the street as many inches higher than the surface of the pavement in the gutter, as is expressed by the result of dividing the width of the roadway between the curbs in feet by 6. Letting C = crown at center, in inches; W = width of street in feet, then $C = \frac{W}{6}$. The height of the part of the pavement half way between the center of the street and where it is met by the curbstone on the side of the street in the gutter is best placed at a little more than one-half of the height of the center; this produces a rounded crown.

Upon a 30 ft. street, for example, the crown would be 5 inches, and the height of the pavement half-

way between the center and the side would be $\frac{5}{2} + 1 = 3\frac{1}{2}$ inches above the gutter line. Much judgment and many variations from the above rule are necessary, due to local conditions.

CROSS-WALKS IN BRICK PAVEMENTS.

Are cross-walks or flagstones at street crossings needed with brick pavements?
Taxpayer, Bellaire, O.

If the bricks are of the best quality and well laid on a firm foundation, there is no need of anything besides these paving bricks to facilitate crossing on foot. Nor are cross-walks needed over the adjacent side streets abutting the street paved with brick. A question similar to this is answered with illustration in MUNICIPAL ENGINEERING magazine, July, 1896, page 33.

VALVE BOX AND COVER FOR PAVED STREET.

In your magazine for January, page 29, I noticed an illustration of two bad forms and one acceptable form of valve box for use in pavements, the object being to produce a firm box with a surface flush with the pavement. Is there not danger of the form which you there showed in figure III, being forced down under traffic, if the pavement settles, and thus injure the valve or pipe upon which it may rest?
Subscriber.

If the pavement is laid upon concrete or other solid foundation it will not sink, surely not if a steam roller or other efficient means were first used to consolidate the subsoil before laying the foundation.

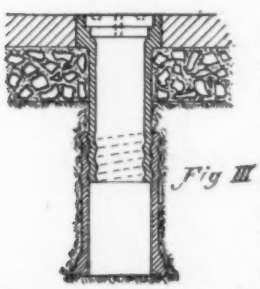
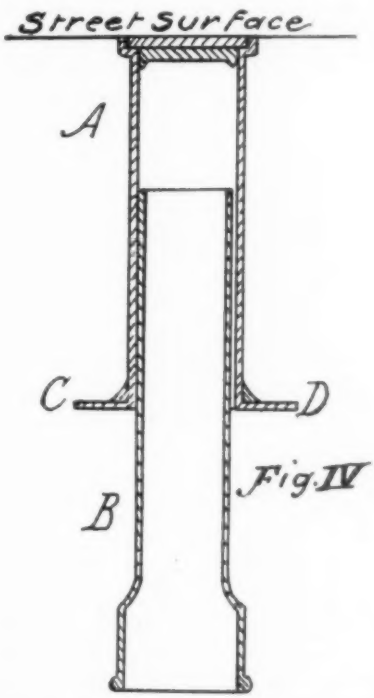


Fig III

For macadam roadways and poor systems of pavement without foundations the valve box (figure III) shown in the January number and reproduced here would not be as suitable as the one which is shown here, figure IV, but for asphalt, granite and other pavements upon fixed foundations of concrete, etc., the box of figure III seems preferable.



A word of explanation concerning figure IV is needed. The part B is placed over the valve; the part A is slid over B until the top is flush with the pavement. The projection C-D is a ring of metal which prevents the upper part from sinking in the soil, except as may be necessary because of the settlement of a weak road surface. The movements of the upper part, A, do not force the lower part, B, down upon the pipe or valve. Such a construction, however, is only necessary upon roadways which settle.

USE OF METERS.

Do you believe in the universal adoption of water meters in cities?
M. A. Lambreth, Cleveland, O.

The time has not yet arrived in

United States cities when it is necessary to compel every house to have a meter. But it would be true economy and justice to the water department of a city or to the water company, when a city is thus supplied, as well as to all persons who pay for the water, if factories, hotels, saloons, restaurants, and all users of water, except houses built to contain single families, were compelled to meter the water. The minimum charge should be a certain small fixed sum, which should allow the use of water up to a certain quantity per annum, beyond which a meter rate per thousand gallons should be charged. Under this arrangement even private houses would soon desire meters, as is the case in several cities, because it has been found that while plenty of water is used, the total amount paid by each user can be reduced, because a large number of persons and companies cease to waste water. The result is that the city has plenty of water and can gradually reduce the meter rates. Under the present system the rates are high and a large number of people are paying for the waste caused by others.

BICYCLES FOR CITY INSPECTORS.

Are bicycles used by city employes in connection with their duties, and at what places? Should a city furnish these bicycles?

M. A. L., Sewer Inspector, Cleveland, O.

They are used for such purposes in all large paved cities. They are generally the property of the persons using them. It would be perfectly proper for the paving, sewer, water, street cleaning or other department, to replace with bicycles a few of the horses which such departments own and maintain. Certain duties in connection with the work of the outdoor employes of cities are better accomplished with a bicycle than with a horse and carriage. Moreover, a bicycle costs less to obtain, and little to maintain.

ASPHALT PAVEMENT AND HEALTH IN NEW YORK.

I have been informed that the mayor of New York has stated that the extended use of asphalt pavements in that city has lowered the death rate. Will you kindly inform me if this is true?

A. B. Campbell, Memphis, Tenn.

Inquiry at the health department of the city of New York resulted in this magazine getting the following copy of a letter and table from the president of that department to Mayor Strong, which shows that the statement originated with the Hon. C. G. Wilson, president of the health department, and was made to Col. W. L. Strong, mayor:

SIR: I respectfully call your attention to the following table, showing the number of deaths and the death rate in July for the years 1892 to 1896, with the number of deaths and the death rate from diarrheal diseases for the same period:

			Diarrheal Diseases.	
Year.	Deaths.	Death Rate.	Deaths.	Death Rate.
1892	5,463	38.37	1,635	11.49
1893	4,704	32.09	1,383	9.44
1894	4,531	30.05	1,197	7.94
1895	4,481	28.61	1,178	7.52
1896	4,238	26.29	973	6.04

The remarkable decrease in the death rate for July and in the death rate from diarrheal diseases for the same period indicates improved sanitary conditions in this city. To such improved conditions the cleanliness of the streets, the asphalt pavements, the improved milk supply and the use of sterilized milk have no doubt contributed. Very respectfully,

CHAS. GEO. WILSON, *President.*

SPEED OF STREET CARS.

As a member of a street committee I am seeking information concerning permissible speed for street cars. Also, on which side of a cross street should a car stop?

Harvey H. Wilson, Savannah, Ga.

Six miles per hour where population is dense, eight miles in the next zone and ten miles are permissible in the suburbs.

Most cities require that a street car stop on what is known as the

"further side" of a street intersection. This means with the back platform of the car, or last car if two or more are together, in line with the sidewalk of the opposite side of the cross street from the direction from which the car has approached. There are good reasons, however, why a car should stop on the first side of the cross street, as at Washington and many other cities.

FLUSHING PAVEMENTS FROM HOSE OR HYDRANT.

At certain times of the year some of our pavements are flushed with water directly from the hydrants, which injures the pavement. Is there any other way to do it without spoiling the pavement from the force of the water?

M. A. S., Troy, N. Y.

While flushing or washing streets is to be commended, if properly done without injury to the pave-

Fig. 1

ment, or clogging the sewers, it is wise to do so. Under no circumstances should water from a hydrant, or through a hose with a one or two inch nozzle, be forced directly upon a pavement of any kind. The joints between granite blocks or paving bricks, whether filled with sand, pitch or cement, are opened by the force of a strong stream or a weak stream repeatedly applied. Even an asphalt pavement, with its dense surface, can be injured by such hydraulic mining.

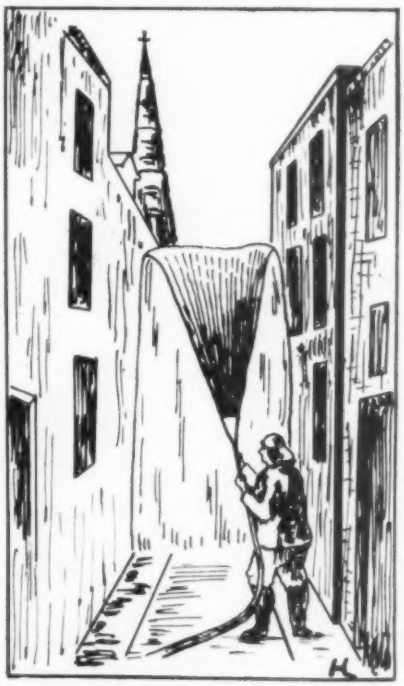


Fig. 2.

This is because an asphalt pavement is really composed of particles of sand held in place by about 15 per cent. of cementing material, namely: the asphaltum in the mixture. Cold water chills the mass and the strong stream forces out the particles of sand.

It is best to attach to the hydrant a short length of hose with a nozzle of special flat form, throwing a broad, thin fan-shaped stream, as illustrated in Fig. 1 on broad streets, or Fig. 2 on alleys and narrow streets. There are other methods of flushing and reducing the force of water which, however, are not obtained directly from hydrants.

ECONOMY OF STREET CLEANING FROM GROOVED RAILS.

I notice by the New York *Herald*, of January 26, that Col. Waring, commissioner of street cleaning, is reported as saying that, if flat-grooved rails were used instead of the various kinds now upon the streets of New York, $500,000 a year would be saved in street cleaning, due to the even surfaces of streets possible with the modern rail. Please state the total annual expense of street cleaning, and what percentage would thus be saved; also whether the saving would be in the same proportion in Chicago, if our rails were like those first mentioned?

An Alderman of Chicago.

The total expense of the street cleaning department of New York during 1896, including new plant, tools, sweeping, removing of ashes and garbage, lighterage, towing, etc., was $2,787,000. Inquiry at the department shows that the statement made by the commissioner was not properly quoted. What he did say was, that if all the streets of suitable grade were paved with asphalt, and if flat grooved tracks should replace all the present tracks, with their high shoulders, the expense for sweeping alone, $1,200,000, would be reduced to $700,000, making a saving of $500,000 annually to the department. The percentage saved with improved rails and smooth pavements would therefore be 18 per cent. of the total expense of the department, or 42 per cent. of the sweeping account.

The methods of cleaning and the conditions in Chicago are different; therefore, the only conclusion possible is that grooved rails on its paved streets would effect a very large saving, because street sweeping would be easier.

[By Charles Carroll Brown, M. Am. Soc. C. E., for MUNICIPAL ENGINEERING.]

CROSS-SECTION ON A HILL-SIDE STREET.

Please advise me what is the best cross-section to adopt on a street when the street is on a side hill and the present gutter and sidewalks on the up-hill side are several feet higher than they are on the opposite side, where shade trees are growing and we do not want to cut the sidewalks down to a level. Should the crown of the street be thrown to one side of the center, or is it better to make more rapid descent from the center to the gutter on the low side, and if so what should be the maximum for brick pavement?

S. G. G., Geneva, N. Y.

Several suggestions will be given of methods of saving the trees. Which are applicable to the present cases could only be determined by careful study of the profile and cross-sections of the street on the ground. It is assumed that the street is a village residence street and that strict adherence to the usual practice on city and business streets is, therefore, not essential. Changes in the gradient of the street may be made more freely on such village streets, often to the advantage of the appearance of the street, and the grade line may be so located as to give some cut on one side and some fill on the other to reduce the amount of one or the other from that required by a uniform slope. Perhaps the most frequent error in paving residence streets is to make the pavement too wide. Excepting the business streets, no village pavement need be more than 30 feet wide and 25 to 27 feet is often sufficient. This width will generally leave enough space that can be used as a lawn to allow sloping banks, with steps for approaches to horse blocks, so that the sidewalks, placed next to the property line can be left at the old elevation. If the trees are next the property line, the sidewalks can be set next the curb and the slope and steps up or down to the house be located on the side toward the property line. On the low side the sidewalk should probably be located next to the curb. It is sometimes possible to put the pavement on

one side of the center of the street, where much room for slope is needed on one side and but little on the other. Curves in the roadway are even beautifiers if carefully managed, and should not be ruled out simply because it is possible to make the curb lines straight.

Another error too frequently made is to assume a form of cross-section that will insure good cross drainage on a level street and use this cross-section everywhere. The result on gradients of more than 2 or 3 per cent. is to make a street which is too slippery and is hard on horses. Steep cross slopes are much more objectionable than steep longitudinal slopes, as the horse has more tendency to slip and has harder work in traveling. As the gradient of the street increases the slope should be flattened. The crown may be thrown to one side of the center and even to the curb line, and the cross-section should be modified to correspond. Thus, if the crown of a thirty-foot street is thrown to the curb, the cross-section should be that of half a sixty-foot street. The following formula for standard cross-sections for varying gradients was prepared by Mr. A. Rosewater and is found to work well in practice. Tables can be prepared by the formula if there is much work to be done.

Let C=crown of pavement in feet, measured from a horizontal line drawn through the gutter, or, in many cases, from a line drawn from one gutter to the other if the elevations differ slightly.

Let w=distance between curbs in feet.

Let i=number of feet fall per 100 feet of street.

Then for asphalt pavements, $C=\frac{w\,(9-i)}{600}$

For brick, stone and wood pavements, $C=\frac{w\,(\ 2(-}{1600}$

Forms of crown differ somewhat, but the side slopes should not be greater than those given by the following table. Divide the distance from the crown to the gutter into twelve equal parts and let c be the crown, as derived by the above formula; then the surface of the street at the points of division will be above the line from which the crown is measured the proportional distances given.

At gutter	ordinate to surface is			0
" 1st	division ordinate to surface is			0.16c
" 2d	"	"	"	0.30c
" 3d	"	"	"	0.44c
" 4th	"	"	"	0.55c
" 5th	"	"	"	0.66c
" 6th	"	"	"	0.75c
" 7th	"	"	"	0.83c
" 8th	"	"	"	0.89c
" 9th	"	"	"	0.94c
" 10th	"	"	"	0.97c
" 11th	"	"	"	0.99c
" 12th	"	"	"	c

MINIMUM GRADES OF SEWERS.

What should be the minimum grades of 24, 27, 30 and 36-inch pipe sewers and of 36, 42 and 48-inch cylindrical brick sewers?

C. N. Schwab, Napoleon, Ohio.

Experience has shown that the rate of flow of sewage should not be less than two feet a second when the sewer is running full or half full, in order to prevent deposit. The inclination as a ratio of the length of sewer to a fall of one foot to insure this velocity can be readily approximated by multiplying the diameter in inches by 50. Thus a 24-inch sewer would have a fall of one foot in 1,200; a 27-inch, one in 1,350; a 48-inch, one in 2,400, etc. These inclinations will give velocities somewhat greater than two feet a second for large sewers. If the sewer is an intercepting sewer, or one of a "separate system" with a uniform flow about half full, this velocity is sufficient. It is also sufficient in a sewer of a

"combined system" where the rainfall is distributed so as to give good flushing streams at frequent intervals, but if the sewers have only the ordinary sewage flow for long periods of time, the inclinations should be materially greater to give self-cleansing velocity at all times. Thus if the sewer runs one-quarter full the velocity is only three-quarters the rate when half-full, and when one-eighth full the velocity is only about one-half that rate. Sewers are frequently constructed with less inclination where local conditions render it impossible to obtain the fall desirable, and when so constructed provision must be made for convenient methods of cleaning the sewers whenever necessary on account of deposits in the slow currents. Pipe sewers do not usually have as uniform flow of sewage as the brick sewer mains, so that it is not usual to make any distinction between pipe and brick sewers in computations. For main lines in a separate system pipe sewers well laid will carry more sewage than the ordinary brick sewer, but such extravagant claims as one that a 30-inch pipe sewer will carry as much as a 36-inch brick sewer of the same inclination have not sufficient foundation.

BOOKS ON STREET CONSTRUCTION.

Kindly advise me as to the most recent and best works on street construction applicable for work on city streets. Also books on instrument work in planning and laying out the same.

Stanley Ruffin, Boston, Mass.

The recent books on street construction are "City Roads and Pavements," by W. P. Judson ($1); one on "The Construction of Roads and Pavements," by A. T. Byrne, and "Pavements and Roads," a compilation by E. G. Love ($5). These probably contain the principal points in modern practice. For instruction in instrument work, a small book and a good one is "Surveying Instruments and Operations," by I. O. Baker. Staley's edition of Gillespie's "Surveying," the latest edition of which is now in preparation, will have details of city work, and "Johnson's Surveying" is also excellent. There are more extended treatises making applications of instrumental methods to all branches of surveying. A small book by Alfred P. Rockwell, on "Roads and Pavements in France" ($1.25), is a compilation of the approved methods of construction in that country. MUNICIPAL ENGINEERING will furnish any book at list price.

COST OF STREET SPRINKLING.

Have you any information on file, showing the comparative cost per front foot for street sprinkling in different cities of the United States? *W. B.*

But few city reports give detailed statements of the cost of street sprinkling. In many cities the work is done by private contract with the property owners, and no account is taken by any city department.

In Brooklyn repaved streets are sprinkled when ordered by the superintendent of streets. Each sprinkler is charged at the rate of $7 a day, and will cover one mile a day of streets, sprinkling twice a day, and about three-fourths of a mile, sprinkling three times a day. The cost is therefore $7 a mile a day for two sprinklings, and $9.33 a mile a day for three sprinklings. The work is paid for by the city. The total cost for 1895 was only $4,724.50.

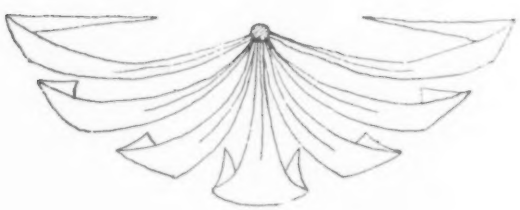
In Milwaukee all the streets were sprinkled by the city at a cost for 1895 of $82,170.90. In seven wards the expense ($28,801.26) was as-

sessed upon the abutting property. In the other eleven wards the expense was paid from ward funds. No statement is given as to area or length of street sprinkled, or number of times a day, or number of days a year. There are 428 miles of streets in the city, of which 213 are improved. If all the streets are sprinkled, the average cost is therefore $192 a mile, or 3.6 cents a lineal foot of street. The cost per foot of streets actually sprinkled is doubtless much more than this.

In Boston, in 1895, 136⅜ carts watered 343.67 miles of street. Part of this work was done by contract and part by day's labor. In the Back Bay district the work was done in 1895 at $424 a mile by day labor, while the same work cost by contract, in 1894, $575 a mile. In the South End district the work was done by the day, in 1895, at $277 a mile, and by contract, in 1894, at $460 a mile with fresh water in both cases. Where salt water was used in 1894 the cost by contract was $630 a mile.

In Mankato, Minn., one contract amounts to $330 a mile for the season from March to October, 1896, the rate being 21 cents a hundred feet per week, and another contract, with varying length of streets, amounts to somewhat more than $265 a mile, the rate being 20 cents a hundred feet per week. The prices in 1895 on the two contracts were 30 cents and 26½ cents respectively.

Indianapolis paid $48,114 for 91.28 miles, or $526 a mile for street sprinkling in 1895, or 5.669 cents a lineal foot of street. The city is divided into districts, and a contract is let for each district at a price per 10,000 square feet. As the entire cost is assessed upon the property, the property owner must pay about 3⅛ cents a foot front on each side of the street. The streets are sprinkled three times a day. The cost in 1894 was $537 a mile. Permanently improved streets are not sprinkled but are thoroughly swept.



BY WAY OF COMMENT.

Portland Cement Specifications.

In our comments on this subject in our August number we indicated some of the outstanding differences in the methods employed by those engaged in testing cement. The paper by Mr. Lewis on the "Development of the American Portland Cement Industry," which is concluded in this issue and a part of which we have heretofore commented on, leads us to some further remarks on the subject.

The proper consistency of the mortar for time of setting or tensile tests is not only one of the most important considerations, but one of the most difficult to define and determine. It seems to us very questionable whether "the trowel has proved to be both quicker and better for working and tempering cements than any mechanical device." On the contrary, it is believed that the variations in tempering the mortar are most frequent in causing differences in the results obtained by various operators and that the remedy must be sought in some mechanical method which will eliminate the "personal equation." While the molds may be "better in design than those used abroad," their form has certainly not been entirely satisfactory, and a change either in the mold or the clip, or perhaps in both, seems to be desirable. The form of the testing machine itself is of secondary importance, as it is only necessary to be able to apply the stress at a given rate and to measure the final force applied.

The requirements suggested by Mr. Lewis are conservative, and generally to be commended so far as standard requirements can now be considered of value. Tests of tensile strength are given an importance relatively less than tests of fineness, specific gravity, etc. This is probably the correct view of the matter as far as short time tests are concerned, but it is believed that the tensile test at long periods has a very great value. It is true that cements are more frequently subjected to compressive stresses than to tension, but the compressive strength is so much greater than the tensile strength that failures are more likely to occur in tension. As the fundamental purpose of cement is to serve as a binding medium, tests of the adhesion of cement mortars to stone and other building materials would doubtless give the most valuable information, but adhesive tests present several difficulties.

The boiling test is not recommended by Mr. Lewis as he considers that this test still belongs only to the field of research. He looks with greater favor upon the warm water test used and recommended by Mr. Faija. Considerable importance is attached to chemical analyses and perhaps properly so, though this test, like short time tensile tests, is likely to be overestimated. M. LeChatelier, in an article presented to the International Engineering Congress, said of chemical tests "neither complete nor partial chemical

anaylsis of the constituents of hydraulic materials can be ranked among normal tests. But chemical analysis may render real service in controlling the classification of a product concerning which there is reason to doubt the declaration of the manufacturer."

In the use of cements Mr. Lewis looks forward to the time when more rational methods shall prevail and the properties of a cement will be more carefully considered in ascertaining its adaptability to a given purpose. We now differentiate Portland from natural cement, but even this evident distinction is not always intelligently made, and the uses to which each is adapted are frequently not understood. To so extend our knowledge of cements that we may be able not only to decide whether a Portland or a natural cement is required for the work in hand, but shall further be able to affirm that a cement should possess certain distinctive characteristics to give the best results, will indeed be a step in advance.

Deficiencies in Municipal Reports. Studies in methods of city government in vogue in this country show the lack of expert service in laying the foundation for departments and the finger of the politician in the details of management. Perhaps no better example of the lack of system or of the purpose to systematically befog the ordinary investigator and prevent the discovery of the actual condition of affairs can be found than the methods of keeping the accounts of the various departments. Portions of the expenditures in a single department may be under the charge of different officers, making their reports in different forms and to different authorities, so that it is impossible to determine the actual results of the various financial operations of the department. An illustration may be taken from the report of the bureau of water of the city of Buffalo, not to single it out for special condemnation, but because the report is recent and conveniently at hand. Page 71 of the annual report of the department of public works gives the total receipts of the bureau of water from all sources as $642,023.40 for the year 1895, and the total expenditures for the same period as $777,606.98, including interest on bonds and three items of new construction. These figures would give an apparent deficiency of $135,583.58, somewhat less than the payments for interest on bonds. At another place in the report it is ascertained that over twenty-five miles of pipe were laid in 1895 and a table of cost of pumpage based on cost of coal shows over 40,000 tons of coal used, costing over $70,000. On page 76 are given the receipts for the year, the principal items being from the city of Buffalo, $29,307.12, from consumers, water not metered, $533,715.88 and metered $59,894.48. These with items of corporation cocks, labor and supplies, builders, street repaving,

sale of old material, turn-on fees, new boxes, flushing sewers and hydrants, tapping fines, street sprinkling, sundries and refunds, make the total given above. On page 77 are given the disbursements for extensions and improvements: new engine, $25,900; new boilers, $7,000; tunnel, $27,554.08; meters and meter repairs, $5,288.70, and smaller items for corporation cocks and services, new horse troughs and hydrant covers, addition to boiler house, conduits and wells, reservoir, sidewalks, horses fountains, new plant, amounting to $321,387.99; also for maintenance and repairs, including $164,879.24 for interest on water bonds, $60,000 for bonds, $5,331.63 for fire hydrant protection, $6,921.19 for repairs of engines and boilers at pumping station, and smaller items for meters and meter repairs, repairs of buildings, vehicle and harness, office expenses, printing, leaks, inlet pier and tunnel, telephone, bridge crossings, tools, maintenance of horse troughs, electric light plant, postage and incidentals, ice and slush labor, turn-off supplies, damages, taxes, gas, extra help, amounting in all to $456,218.99. The two totals for extensions and maintenance together make the total expenditures given above.

It will be noted that the disbursements do not include a salary list, nor any labor except $235 for extra help on street repairs; that they do not include the $70,000 item for coal consumed, though the exact cost is known and given elsewhere, and also that they do not include the cost of the large amount of pipe laid nor the expense of laying. Doubtless these items are taken care of in some other department, but they do not appear in the report of the Department of Public Works, and the reports of deficiencies, given on pages 71 and 76, are very misleading, and are far from giving the actual facts. The so-called "deficiency" would be much greater if all the facts were known. No objection is here made to the management of the works; they may be very economically administered, and the city is probably paying no more than its fair share of the cost of running the works, but a system of bookkeeping should be adopted which will show all the facts, that all interested persons may know the actual condition of affairs. It is very probable that the city is not paying its full share of the expense of the water department, but with the present system of accounts it is very nearly impossible to determine its proper share, and from the reports of the departments no complete data can be gathered. A similar criticism was made last month of the report of the Pittsburgh Department of Public Works, which gives the expenditures of the department of water but no statement of receipts. Many other cities are in similar condition, and are sadly in need of a little elementary instruction in keeping accounts and concentrating management of departments.

The Chemical Constituents Of Portland Cement.

Some time ago MUNICIPAL ENGINEERING submitted to some of the Portland cement manufacturers of the United States a series of questions which were designed to bring out the prevailing opinions concerning the proper proportions of the essential ingredients in Portland cement, and the allowable limits of those objectionable ingredients which can not always be eliminated. The number of manufacturers replying to these questions was not as great as we had hoped, and we fear that this may be partially accounted for by the fact that a few manufacturers appear to consider that the chemical composition of their product is not a matter for engineers to criticise; but that the latter should be concerned only with the results achieved. We believe, however, that this is a mistaken idea, and that the manufacturer of good cement should take every opportunity to enlighten the users of cement concerning the character of their products. Some of the leading manufacturers appeared to share in this belief and submitted their opinions, which we published in MUNICIPAL ENGINEERING for October, 1896, and February, 1897.

We wish to briefly discuss these replies now, making a few comparisons which may in some cases show the several opinions to be more consistent than they would at first appear.

The first question was "What do you consider to be the proper relation among the following constituents of Portland cement: Lime, magnesia, silica, alumina, iron oxide?"

To this Prof. Newberry, manager of the Sandusky Portland Cement Company, replied that the "lime should be about equal to 2.8 times the silica present plus 1.1 times the alumina present." In making the statement Prof. Newberry doubtless has in mind the ideal cement, containing silica, lime and alumina only, the silica and lime occurring as tricalcic silicate, $3CaO, SiO_2$, which is the chief hydraulic element in Portland cement, and the lime and alumina occurring as $2CaO, Al_2O_3$. This rule, if applied to commercial cements, would show them to be quite deficient in lime, and it is doubtless not intended for such application.

In the reply to this question submitted by Mr. Bartholomew, in behalf of the Buckeye Portland Cement Company, he intimates that the chief role played by the iron oxides and alkalies is to act as a flux in burning. The limiting proportions of the various ingredients as stated by the Glens Falls Portland Cement Company are practically the same as those given by M. Candlot,* and the proportions given in the last column of the table would, for most materials, prove very satisfactory. The proportions preferred by Mr. Fisher of the National Building

*Ciments et Chaux Hydrauliques, page 75.

Supply Company (MUNICIPAL ENGINEERING, February, 1897) are nearly the same as these. The formula given by Mr. Plankinton, of the Western Portland Cement Company, may be used to determine approximately whether a cement is properly proportioned, but it is not what might be called a rational formula, since it assumes that silica combines with lime in the same proportions by weight that alumina does. It is thought that Mr. Carney, of the Mankato Cement Works, must refer to natural cements in the analyses he gives, since such wide variations in proportions can not be tolerated in Portland cement.

The second, third and fourth questions relate to the allowable limit of combined magnesia in Portland cement, the use of cements that contain magnesia in works built in the sea, and the relative harmfulness of free lime and free magnesia. Prof. Newberry states that his experiments tend "to confirm the opinion of many German authorities, that magnesia remains *free* in cement." He also says that free magnesia shows some tendency to expand and crack at long periods, but is emphatic in the statement that it is not more harmful than free lime. This latter opinion agrees with that expressed by M. Le Chatelier, an eminent French authority, who says that the accidents occasioned by magnesian elements, "have been due to the employment of badly proportioned cements, containing free, uncombined magnesia, and too small a quantity of clay." M. Le Chatelier evidently considers that magnesia may be combined in cements, and that it is harmless when replacing lime. On the other hand, certain German authorities consider that magnesia is practically inert, acting as an adulterant, and that an equivalent of the magnesia should be added as lime.

Mr. Plankinton considers that free magnesia is more harmful than free lime, since it hydrates slower. It would be more treacherous on this account, expanding after the work is well hardened. Several of the manufacturers place the allowable limit of magnesia at the conservative figure of 3 per cent. The variations in opinions indicate the uncertainty prevailing, and show that further investigation of the matter is required.

It is the general opinion that sulphuric acid is particularly injurious in cement for use in sea water and that the limit should not exceed that stated by some of the manufacturers, namely, two per cent. This subject is also under investigation, and, as stated by Prof. Newberry, the exact nature of the action of this ingredient is not known. Although the sulphuric acid occurs in combination with lime, it is, of course, given in analyses as sulphuric acid.

As to the addition of sulphate of lime to cement the opinion appears to be quite general that two per cent. is not harmful. Some experiments recently made confirm

this opinion; the practice of adding sulphate of lime to cement to make it slower setting is very general, especially in Germany. But a very small amount, one or two per cent., is required for this purpose.

The combinations in Portland cement containing alumina and iron oxide are in general weak, and may deteriorate, especially in air. The alumina compounds contribute to the first setting of the cement. The principal function of these two ingredients is to act as a flux to facilitate the combinations of lime and silica. Hence, while their presence may not be necessary or desirable in the finished product, they are required to bring about the desired reactions. This fact is brought out more or less clearly in nearly all of the replies received.

State License Of Surveyors and Engineers. A committee of the society of engineers and surveyors of Nebraska has prepared a bill establishing a State Board of Civil Engineers, consisting of the governor, attorney-general and state superintendent of public instruction, and regulating the practice of civil engineering in its several branches, including that of surveying. The title of the bill would indicate that the difference between engineering and surveying was recognized as sufficiently distinct to require special effort to bring them under the same law, but there is nothing in the bill itself to provide for different treatment of men professing to follow the two lines of practice. As a consequence, a strict enforcement of the law (if the bill becomes a law) would prevent any one not a civil engineer from following the practice of surveying. The bill is said to be as close a copy of the laws regulating the practice of medicine as the subject would permit, and is evidently too close a copy to be practically applicable when its effort to combine the two lines of practice in one is also considered. Engineering is a learned profession quite as much as is medicine or the law, and should be treated as such. An attempt to regulate the qualifications of attorneys and notaries public, or of physicians and trained nurses by the same modes of procedure, and to issue the same certificates of qualification to both classes, would be quite as reasonable as to place engineers and surveyors under the same blanket certificate of qualifications.

The demand for some regulation of the practice of both engineering and surveying is becoming quite general, and appears in all ranks of the profession. The Canadian Society has attempted, with some success, to satisfy the demand. The American Society as yet refuses even to listen to the demand. In the lower ranks it appears in the form of bills for state regulation of practice. Few suggestions have thus far been generally acceptable, for no one has as yet made a careful and competent study of all phases of the question. The usual legislative attempt fails, as does the

one in Nebraska, to make fundamental distinctions which are essential to any measure of success. The agitation evidenced by these bills is very commendable, and out of the present chaos of propositions will come good to the profession, whether in the form of legislation or not.

Cincinnati's New Water Supply. In MUNICIPAL ENGINEERING for May, 1896, page 357, will be found an abstract of the report of the engineer commission appointed to report upon the source of a new supply of water for the city of Cincinnati, method of treatment of water and cost of works. The report recommends filtered Ohio river water, and gives detailed estimates of cost amounting to nearly $6,500,000. An act was passed by the Ohio legislature in April, 1896, authorizing a water commission to construct works and enabling it to issue bonds to the amount of $6,500,000.

The validity of the law was attacked on several points and the matter was before the courts until a decision was reached, Feb. 1, 1897, upholding the law with the exception of one section. This section authorized the water commission to contract with a construction company for the works and to lease the works for a period of forty years or less with privilege of renewing the lease and of purchasing the works at fixed periods of time, and has been declared unconstitutional by the supreme court of the state. The board of water commissioners was appointed in April, though unable to proceed until the law was passed upon by the supreme court, but has now permanently organized, appointed its secretary, authorized the issuing of $50,000 of bonds for preliminary expenses and requested a consultation with the engineer commission regarding the principles and the details of their report.

The city water supply has been in bad condition both as to quality of water and character and condition of pumping machinery for many years, and is to be congratulated upon the prospect for a material improvement in both directions at an early day. The works have heretofore had an annual deficiency in revenues not materially exceeding $100,000, a sum much less than the city at large should pay for the general benefits and for fire protection and public uses. This deficiency will probably be reduced materially when the new machinery is in operation, and the interest and sinking fund charges on the old works will be nearly wiped out before the new works are completed, so that, notwithstanding the greater interest charge, the total deficiency under the new conditions will not be much larger than at present, and will not exceed the amount the city should pay, unless there is gross mismanagement of the finances of the department. There is some opposition to the project among persons who see a deficiency in revenues to be probable, which must be met by general taxation. The ordinary

user of small quantities of water, if a payer of taxes, objects to the increase in the tax rate, because it slightly affects his pocket, forgetting that the deficiency must be met in some way, and that if water rates were increased for that purpose the effect upon his pocket would be still greater.

Proposed Free Water in Detroit.

The operating expenses of the Detroit water-works for 1895 were $107,000, which is but little more than the average for the last eight years. Much new construction has been necessary, the average expenditures for the last eight years having been nearly $300,000 a year. Interest and retirement of bonds accounted for about $130,000 of expenditures in 1895. Detroit was noted for some years for its high per capita consumption of water, the amount running over two hundred gallons a day. Closer inspection and the introduction of meters has reduced the waste of water so that the amount pumped in 1895 was practically the same as that pumped in 1887, although the population is nearly 100,000 greater. It has been proposed to make the uses of water free, the cost of the department to be borne by general taxation. The enormous increase in plant that would be necessary on account of the probable large increase in waste and the certain large increase in consumption would materially increase the expenditures for new construction as well as for pumping expenses. A tax rate of about 3 mills on the dollar would be necessary to meet the expenditures of 1895. The injustice of taxing the property according to its value, without reference to the amount of water used, is also evident. At present all users of water pay the same for each faucet, but under the proposed system the more valuable property would pay large rates and cheap property very low rates. Manufacturing establishments using large quantities of water would also be very greatly favored. Thus, for August, 1895, a music store, assessed valuation $81,000, used 19,250 gallons of water and paid $1.35, and a brewery, assessed valuation $54,000, used 8,037,000 gallons and paid $179.60. Under the proposed method the music store would pay, say $15, and the brewery $10. Unquestionably the effect upon fire insurance premiums should be met by a tax upon valuations, but the increase in value of property by reason of water connections would be more nearly met by a frontage tax, assessed once or annually, and it is evidently unjust to fail to tax large users of water according to the amount they use.

Methods of Assessment for Public Improvements.

In line with the article in the February number of MUNICIPAL ENGINEERING on "Methods of Paying for Street Improvements" is a statement of the method adopted for assessing and paying for the large east side sewer in Rochester, N. Y. The city issues bonds to pay for the construction of the sewer and re-

imburses itself by making assessments upon the property benefited in forty annual payments. The entire assessment is not made at once, but one-eighth of the entire amount is assessed upon the property at the beginning of each five year period, so that eight assessments at intervals of five years will be necessary to cover the entire amount. The sewer is a very large one, benefiting a large district, much of which is not yet improved. The methods of assessment give an opportunity to distribute the benefits according to the development of the district. For example, a property which is now undeveloped and of small value will pay but a small proportion of the first assessment. If the same property is improved more rapidly than other property in the district it will pay a larger percentage of the assessments made after that improvement takes place. This appears to be a very equitable solution of the problem so frequently met of properly assessing the cost of district sewers. The most frequent solutions are that assessing the cost of the sewer according to the area or frontage of lots, which makes the less valuable part of the district pay more than its due share, and that assessing according to the value of the property at the time the sewer is built, which is likely to make the more valuable part of the district pay more than its due share. Each piece of property will also have an assessment for local sewer when such local sewer is built. An additional advantage is that arising from the fact that the assessment against a piece of property at one time is never more than one-eighth the total assessment to be made, so that the property does not have the appearance of being overloaded at any time. This advantage is, of course, more apparent than real.

Sewage Disposal at Ithaca, N. Y. A considerable portion of the city of Ithaca, N. Y., is situated on a low flat at the head of Cayuga lake, but little above the level of the sluggish Cayuga inlet, and subject to overflow when the water in the lake is at a high stage for any reason. For some distance back from the lake this flat is an uninhabited swamp. The city's sewage can not be discharged into the inlet and there is not sufficient fall to discharge it by gravity into the lake through a sewer across the flats.

The sewage of the city is therefore brought to a pumping station and is lifted by a centrifugal pump a height of fifteen feet and discharged under pressure through a pipe across the flats, into the lake. There are two pumps for alternate use and two boilers. In the station are also two air compressors which furnish compressed air to two ejectors situated at some distance from the station. A section of the city south of State street is too low to drain to the pumping station and is served by sewers running to the ejector chamber, where

the sewage is lifted thirteen feet by the compressed air ejectors, and thence flows by gravity to the pumping station. Ejectors and compressors are also in duplicate. Four men are required to manage the pumping station and ejector plant, two by day and two by night. About nine tons of buckwheat anthracite coal are now used each week and the cost of the coal for a year is estimated at $1,000. The sewage system is new and not yet fully used by the citizens, so that the amount of sewage to be disposed of will probably increase quite rapidly for some time.

Sewage Disposal at Mansfield, O.

The city of Mansfield, drains into Rocky Fork, a small stream having a slight fall. Sewers heretofore constructed discharge into the stream. An extension of the sewerage system is contemplated, and the policy of the State Board of Health is against the increase in the pollution of the stream. It is therefore proposed to build the sewers needed and to pass all the sewage of the city through a chemical precipitation plant similar to the one at Canton, O., which is quite successful and capable of producing as satisfactory an effluent as any of the works upon that principle. To reduce the amount of sewage to be treated to a minimum, the new system of sewers will be designed to carry house drainage only, and separate storm water sewers for street drainage will be provided as may be necessary. Rough preliminary estimates give the cost of the house sewers as about $125,000, and the storm water sewers as about $85,000, and there will be an additional amount necessary for the sewage disposal works and for pumping machinery to lift the sewage from the low portions of the town into the disposal works. It is proposed at this time to spend $71,000 in building the disposal and pumping works, and laying two main sewers, one to carry all the sewage possible to the works by gravity, and the other to carry the sewage from the low lands to the pumping station.

Proposed Intercepting Sewers for Chicago.

Chicago has had much trouble with sewage for many years on account of the nuisance caused in the Chicago river and on account of the pollution of its water supply. Some attempt was made to remedy the first by pumping a large quantity of water daily from the river into the old Illinois and Michigan canal to run west into the Illinois river, thus causing a slight flow of lake water into the Chicago river. The pumping works have long been inadequate. The second has been largely remedied by extending the intakes of the water-works several miles into the lake. Some intakes have not yet been extended, and one, after extension, was found to give more impure water than before, probably because the intake crib was located in a current from the mouth of the river. In times of heavy rainfall and floods the territory west of the city, which

usually drains to the south and west, has heretofore turned its overflow into the water-shed of Lake Michigan, and with the flood waters from the city has furnished enough polluted water to affect all the water-works intakes, even those farthest out in the lake. The great Chicago drainage canal will take the place of the present pumping station and will, by gravity, drain towards the south and west to the Illinois river from the Chicago river and draw from the lake enough water to keep the river reasonably clean and prevent river water from entering the lake, except, possibly, in times of heavy and long-continuing rainfall. This canal will be completed in about a year ready for operation. To obtain the full benefit of the canal the sewage now discharged into the lake from the portions of the city lying north of Fullerton avenue and south of Twelfth street must be turned into the canal or river. All of the city between Twelfth street and Fullerton avenue now sewers into the river. The city is very flat and the distances are great, so that the problem of disposal of the sewage is not an easy one to solve. In October a commission was appointed consisting of Joseph Downey, Wm. Sooy Smith, George H. Benzenberg, Samuel G. Artingstall and Lyman E. Cooley to report upon the possible methods of disposing of the sewage and improving the water supply. This commission made its report February 10. Each member of the commission has special qualifications for the work, Mr. Downey being commissioner of public works for the city, General Smith a designing and constructing engineer of many years' experience and with special knowledge of the conditions in Chicago; Mr. Benzenberg the city engineer of Milwaukee for many years, familiar with Lake Michigan sewerage and water problems; Mr. Artingstall, a former city engineer of Chicago, and Mr. Cooley, having been connected with the Chicago drainage canal in one capacity or another from the inception of the idea to the present time almost continuously.

The report of the commission gives in considerable detail the method considered best, with careful estimates of cost. In brief, the system consists of intercepting sewers to take from the present sewers discharging into the lake the ordinary flow and carry it to points where it can be pumped directly or indirectly into the river, the reconstruction of some sewers to flow west into the river instead of east into the lake, and the provision for other sewers in thinly populated districts to flow into the canal or into channels which ultimately reach the canal. To take care of the sewage from the northern lake front district, intercepting sewers costing $929,770, and pumping machinery and appurtenances, including land costing $183,000, will be necessary, costing, with ten per centage added for engineering

and contingencies, $1,224,047. For the southern lake front district there will be required for intercepting sewers and relaying old sewers, including automatic gates, $1,530,710, and for two pumping stations, land and appurtenances, $440,000, making, with the ten per cent. added, $2,167,710, or a grand total of $3,391,757. Part of the sewers will discharge by gravity into the river, from some the sewage must be pumped, and some which are below the level of the lake will have connections whereby the lake water can be forced though them by low lift pumps, such as the one in use at Milwaukee for cleansing the Milwaukee river, so that the discharge of this additional sewage into branches of the Chicago river off the main flow of lake water to the drainage canal will not produce nuisance in these branches. These intercepting sewers and the reconstructed lines will provide for the ordinary flow of sewage which will be led away through the drainage canal with sufficient dilution by lake water to prevent nuisance. Floods are still liable, however, to reverse the direction of flow to some extent for comparatively short periods of time, and overflows from existing lake front sewers will at such times discharge into the lake, so that there is still some probability of pollution of the water supply. The commission, therefore, recommends the extension of the intake tunnels to points four miles from shore, and ultimately to points where the depth is fifty feet. The report also touches upon the plans for the sewerage of the extreme southern part of the city, and for Evanston in a general way.

CURRENT INFORMATION.

MUNICIPAL OWNERSHIP STATISTICS.

An investigation into the municipal ownership of big enterprises is being carried on by the different state bureaus of labor and the federation department of labor. The chief aim of the inquiry is to collect data from all gas, electric light or water works under municipal control. Also, to collect data bringing the cost to the consumer of water, gas or electric light under municipal management with the cost of a like product under private control, and to find the cost of the different products under the two methods of management. There are thirty-two state offices, but some are unable to join in the inquiry, and from such states the department will collect the facts. The results will be brought together, compiled and analyzed by the departments of labor, while each state participating in the canvass will publish the data belonging to it. Thorough co-operation will be secured in this way and the work accomplished with the least possible delay. The investigation is based on the desire of all parties on both sides to learn the extent to which the idea has been carried, and the principles involved do not constitute any feature of the investigation, and whether municipal ownership is o. is not desirable has no place in the investigation. Under the supervision of Commissioner of Labor Wright the department of labor at Washington, D, C., is sending blanks to the different state officers, and the results will be available for tabulation in the different states within the next two or three months. A summary of all the facts will be published by the department, and will be embodied in a special report to congress. The idea of this canvass had its origin in a resolution adopted at the twelfth annual

convention of the National Association of Officials of Bureau of Labor Statistics in the United States, in June, 1896.

EQUITABLE ASSESSMENTS FOR SEWERS.

Since the Supreme Court's decision regarding water shed assessments in the Beechwood avenue sewer the city officials of Pittsburg, Pa., are considering plans and methods for complying with the law and yet not have the city practically taxed for the construction of main or trunk sewers. The most favorable plan that has been presented yet to the officials is that when a trunk sewer is to be built and the probable cost is known, those property owners not on the line of the main sewer, but whose properties will be benefited by it, shall guarantee that they will pay their share of the cost, after it has been determined what the abutting property owners and the city must pay. It is thought that improvements can be made in this way, and at the same time the city in general be not forced to pay an inadequate share.

THE COLUMBUS SEWER ARBITRATION CASE.

A question has arisen at Columbus, O., as to which of the four judges in chancery has a right to hear the review of the board of arbitrators in the West Side sewer case. Under the terms of the contract to arbitrate the differences existing between the city and the contractors, the award was to be reviewed by the judge sitting in chancery. The city construes this to the effect that the judge sitting in chancery at the time the motion is filed is the proper person to examine the award, while counsel for the contractors thinks that any one of the four judges has a right to hear the case, as all have equal chancery powers, one exercising this power exclusively each term merely by agreement. The judgment of the review means the dismissal of further prosecution of the criminal features of the case, for, if the decision is against the city, a nolle will probably be entered at once against the indictments, and, on the other hand, if the arbitrators are sur-reversed the case will no doubt be pushed.

REGULATING A ROCK-CRUSHING PLANT.

An amendment regulating the operation of the rock-crushing plant at Folsom, by fixing the cost of crushed rock at 40 cents, instead of 25 cents per ton, was put to vote at Sacramento, Cal., and lost. The amendment was introduced by Senator Bert, who admitted that he had offered it at the request of the owners of quarries, who represented that they could not compete with the state plant if the price were fixed at the figure named in the bill. Senator Bert said that a mass meeting of merchants and manufacturers had recently been held in San Francisco at which hundreds had protested against the continuance of the rock crusher at Folsom. Several senators spoke against the amendment, arguing that the output of the crusher would never enter into serious competition with free labor, and that it was absolutely necessary to find employment for the convicts in the prison. The bill was passed as originally introduced.

MUNICIPAL OWNERSHIP OF PAVING BRICK.

Commissioner McVicar of Detroit, Mich., advocated recently that "the city should purchase the entire output of a brick yard at a fixed figure per 1,000, then locate a good inspector at the brick yard and see that the brick all came up to specifications. The city could then sell the brick to paving contractors at cost price."

SEWER ASSESSMENTS IN PENNSYLVANIA.

In filing affidavits of defense in four suits brought by the city of Allegheny, Pa., to obtain municipal liens on certain property Attorney Elphinstone attacks the constitutionality of the method of sewer assessments, claiming that it is unjust and illegal. Mr. Elphinstone will endeavor to have the courts declare them unconstitutional, and, if successful, the result will be that more than 1,000 property-owners on about fifty streets, which have been sewered and assessments never collected, will probably bring suit. The city, it is alleged, arbitrarily laid a sewer last summer, and about the middle of January, 1897, filed a municipal lien against the property-owners. In their affidavits of defense the defendants allege that the property was sewered by a private sewer in the rear fully sufficient to carry off all sewage on the thoroughfare; that it is rural property and that assessments were made by the foot front, no attention being paid to the value of the property in depth, etc. They claim that the acts under which councils are given the right to lay sewers for the city provide an arbitrary assessment of benefits by an officer of the city—the city engineer—in connection with the committee on streets and sewers, according to a uni-

form rate fixed by councils for all sewers. That no provision is made by these acts for legal viewers or for appeals by the property-owners so assessed; the only provision as to viewers being those appointed by councils; that such acts authorize a uniform assessment against all properties regardless of the extent of the benefits conferred; this, by an illegal tribunal; that the acts above quoted by their harsh and unjust provisions, including denial of free access to the courts, are unconstitutional and violative of the bill of rights.

Attorney Elphinstone says that while the city has been operating under the act of 1861, since it was passed, and has arbitrarily fixed the price to be paid by property-owners per front foot at $2, irrespective of the depth of property or its value, he does not think that the property-owners, thousands of whom have paid the assessments, can recover because the city will immediately seek curative legislation at Harrisburg and commence to lay its sewers under the act of 1891, which includes sewers as well as streets, and was passed for all cities of this class in the commonwealth. The first charter of the city was obtained some time in the early 40s, but all of the principal sewers have been laid since the passage of this alleged illegal act; accordingly every property-owner in the city has suffered unjustly and the city has been the gainer by the acts related above. Property-owners have no remedy, however, if curative legislation is secured. The city has been fair in some ways, but it does not remove the fact that all the power has been in the hands of councils, to do or not to do, as they saw fit.

INQUIRY REGARDING ASPHALT IN PITTSBURG.

The special committee appointed by Pittsburg councils to investigate the merits of various brands of asphalt held a meeting Feb. 5 and passed a motion requesting Director E. M. Bigelow, of the Department of Public Works, to make a statement concerning the experience of other cities in the laying of asphalt pavements, giving price, durability, etc., and to report to the committee at a meeting to be held March 5.

LEGAL WATER RATES IN CALIFORNIA.

A written opinion was rendered Jan. 31 by Judge E. S. Torrence of the Superior Court in the case of Ella B. Ward vs. the San Diego Land and Town company, San Diego, Cal., which is in direct opposition to the decision rendered by United States District Judge Ross. Judge Torrence declares that the decision hinges on whether the defendant has the right to increase water rates heretofore charged, and this rests upon the proper construction of the powers and duties of a water corporation under the constitutional laws of the State.

The defendant claimed that in the absence of fixed rates made by supervisors it has the legal right to charge and collect rates as it deems proper and to increase them whenever the business requires it, and also that the company, being a quasi public institution, it would be against public policy to hold it so bound to previous contracts as to preclude it from exercising its law-given right.

The opinion says this new and startling doctrine was not until recently supposed to be embodied in the law which governs the rights of persons carrying and distributing water. It is certain that the intent of the act of 1885 was to have a certainty about water rates and that there should be some permanency as to the period during which rates once established should continue to be collected. The statute gives the water corporations no right to change rates once established and collected, and the constitution prohibits the right to collect rates except by authority of and in the manner prescribed by the law, and the statute provides that when rates once established by the supervisors have been abrogated by the board, the actual rate established and collected by the company shall be deemed legally established rates.

BICYCLE PATHS IN CALIFORNIA.

In order to facilitate a scheme for building an elaborated bicycle path between Pasadena and Los Angeles, Senator Simpson has introduced two bills in the legislature, one with a view to the granting of franchises for the construction of paths and roads, either on the surface, elevated or depressed, on, over, across or under the streets and public highways, for the use of bicycles, tricycles, motor cycles and other horseless vehicles for a term not exceeding fifty years. The other bill extends the right of eminent domain to the condemnation of land for rights of way for bicycle paths or roads.

ASPHALT PAVEMENTS DAMAGED BY OIL.

Attention has been called to the necessity of requiring the oil companies to properly protect their delivery wagons so that the

oil will not drop on the asphalt pavement, by City Engineer Meyers, at Pittston, Pa. An ordinance has been ordered drawn, by the Select Council, making effective Mr. Meyers's suggestion.

POOL OF GERMAN CEMENT MANUFACTURERS.

A recent British consular report says that nearly all the German cement works have joined in a syndicate the object of which is to prevent undue competition and maintain prices. In 1896 the business was active and the production was greater than in the preceding year, and in spite of the competition and the low prices, fair dividends seem to have been the result of the year's work. The total quantity exported by sea amounted to 199,677 tons, of the value of $1,845,600, being a very large increase in volume, but a decrease in value compared with 1894. Of the total quantity exported the United States took half, and the next largest customers were the American states on the Pacific, Brazil and Australia, while considerable quantities went to the different parts of Africa. The largest European customer was Norway.

DES MOINES' PLAN FOR ACQUIRING CONTROL OF WATER WORKS.

Terms have been decided upon by the Council and the Water Company at Des Moines, Ia., which will settle the water question, which has been in litigation so long. The proposition provides for the appointment of three trustees, who shall take charge of the works for the benefit of the city. The trustees are to be appointed, one by the city, one by the Water Works Company and one by the agreement of these two. The plan is to have the trustees mortgage the water works for the amount of the present bonded debt, $985,000, and present bondholders to hold the new mortgage. The proposal will involve the right of the city to buy the works at any time within twenty years, and if the city accepts the proposal the Water Works Company will stipulate that all suits now pending will be dismissed, the city will be required to pay the judgment now standing against it, and about $20,000 which is due from the city for back rentals. In the dismissal of pending suits the company will agree to pay half the costs, and the city the other half. The city will also be asked to pay annually the taxes of the company. The proposition means, in substance, that the rate of interest that must be paid will be reduced from 6 to 4 per cent.; that the city will pay the taxes, instead of paying for public water service; that in case there is a profit from the operation under these terms, it shall be applied to reducing the debt. The city will have the option of buying the plant.

ALLOWANCE MUST BE MADE FOR SIDEWALKS.

Judge Henry C. Fox, of the Circuit Court, rendered an interesting decision Feb. 15, in the case of a property-owner against the city of Richmond, Ind. The city decided to improve a street, but in order to do so would have to take several feet off the property-owner's ground. The commissioners assessed the damage at $1,500, but the owner refused to accept this and appealed to the court, where a jury allowed her $2,900. To avoid paying this the city decided to improve the street without touching the property, and in order to do this the gutter would have to be brought up against the owner's ground, allowing no sidewalk on that side of the street. The owner secured another injunction, Judge Fox holding that the street cannot be made in the matter contemplated by the city.

PROPOSED AMENDMENTS TO THE CHARTER OF SAGINAW, MICH.

Proposed amendments to the charter of Saginaw, Mich., provide for the abolishment of the Board of Water Commissioners, the Board of Public Works and the Board of Cemetery Commissioners, and create in place, one board, to be designated the Board of Public Works, which shall have charge of all the public works of the city after being ordered by the Council. In addition to its present duties the Board of Public Works shall perform all the duties that formerly devolved on the Board of Water Commissioners and the Board of Cemetery Commissioners, and perform such other duties as the Common Council may, from time to time, prescribe by ordinance or resolution; also, abolish the office of Superintendent of Streets, and in place thereof create the office of one Superintendent of Public Works who shall be appointed by the Board of Public Work and confirmed by the Common Council, and when so appointed, shall have charge of the public works under the direction of said board, and shall have power to hire and discharge persons on any public work of the city under his charge. Another amendment provides that when a street is ordered repaved by the Common Council, one-third of the cost of said improvement, together with the cost of street intersections, is to be paid for by the proper taxing district, and two-thirds of the

cost of any such improvement to be paid for by the property specially benefitted thereby. The Common Council shall not grant any special franchise to street railway companies on any of the streets of said city until sealed proposals have first been duly advertised.

PROPOSED PARK LEGISLATION IN KANSAS.

A park bill has been introduced in the Kansas legislature which provides for the appointment of a park board which is to consist of five citizens, to be appointed by the Mayor subject to cancellation or rejection of the City Council of any city of 40,000 inhabitants. The members of the board must give bond as fixed by the Mayor and Council, and must serve without pay; they shall organize by selecting a president, an auditor and treasurer from among their own number, but the secretary must not be a member of the board and will work on a salary. The board shall have the power of dividing the city in park districts and securing by purchase, condemnation, gift or device, land for parks, streets or boulevards. The commission may also act in conjunction with the board of county commissioners in regard to parks and boulevards outside of the city limits. The commission has the appointing power of engineers, surveyors, clerks, park police and other officers for the care and management of parks and boulevards, but for any member of the board to have any interest in any contract under their control is to commit a misdemeanor.

CLASSIFICATION OF PAVED STREETS.

An ordinance is before the City Council of Oakland, Cal., which classifies the streets, alleys, lanes and courts of the city into main thoroughfares, business streets and residence streets, and establishes specifications covering the character of the work to be done on each class of the streets. The measure provides that when these specifications are followed out, streets so improved shall be accepted by the city from the property owners and thereafter maintained by the municipality. The specifications are set forth in detail as follows:

"Pavements on business streets shall in all cases consist of a concrete foundation at least six inches thick, covered with a wearing surface of bituminous rock, asphalt or wooden blocks, constructed as hereinafter specified.

"Wet adobe or any material impracticable to consolidate into a hard, smooth compact foundation shall be removed to a depth of at least twelve inches below subgrade, and good clay, sand, gravel or loam substituted therefor, and any new material brought on to the street for the purpose of raising the sub-grade to the proper elevation, shall be rolled in layers of not more than twelve inches in thickness with a roller of at least ten tons weight.

"Curbs on business streets shall be built of hard granite of a uniform color and texture, free from cracks, seams or pockets, cut not less than four feet in length and sixteen inches in depth, and with an average thickness of not less than seven inches.

"Gutters on business streets shall be built of basalt or granite blocks of durable and uniform quality. The blocks shall be not less than eight inches, nor more than twelve inches in length, and not less than four inches, nor more than five inches in width, and not less than six inches, nor more than seven inches in depth.

"Main thoroughfares and residence streets shall be improved in the manner and with the materials specified in the resolution of intention for said improvement.

"Unless otherwise specified the construction of all work on residence streets shall be governed by and executed in accordance with the specifications herein set forth, for 'improving and paving business streets,' excepting as follows:

"That upon residence streets the concrete foundation shall not be less than four inches in thickness, and the asphalt or bituminous rock wearing surface shall not be less than one and one-half inches in thickness; also that curbing on residence streets shall be built in accordance with the provisions of section 13 of this ordinance."

The specifications for the wood block pavements embrace the following:

"Upon the foundation of concrete shall be laid redwood or Oregon pine paving blocks, which shall be of a uniform width of six inches by four inches, vertical grain, and from three to six inches in width.

"Redwood blocks shall be of the best quality of butt redwood free from loose knots and bad checks. Pine blocks shall be of best quality of Oregon fir, cut from old-growth timber, solid and close-grained, free from bad knots and checks.

"The blocks shall be prepared before laying, by immersion in a bath composed of hard refined asphaltum 48½ per cent., refined California liquid asphalt 48½ per cent. and animal oil 3 per cent. Both the hard and the liquid asphalt shall be at least 97 per cent. pure.

"After laying, there shall be poured over the blocks, the aforementioned mixture of refined asphaltum and animal oil, while at a boiling temperature, until the spaces between the blocks are entirely filled, and sufficient in quantity to cover the entire surface of the pavement throughout, to a depth of one-eighth of one inch.

"Coarse, sharp sand heated to a temperature of 200 degrees Fahr. shall then be spread over the entire surface of the pavement to a depth of one-quarter of one inch. Oregon pine blocks, when used, shall be kiln dried, before being submerged in the asphaltic bath."

BIG SUIT FOR WATER RATES.

The East Jersey Water company has begun suit against Jersey City, N. J., for the recovery of $500,000 for water furnished the

city from January 10, 1896, to January 30, 1897. The case will be heard by the Supreme Court at Trenton March 12. The water was supplied at the rate of $43 a million gallons, and while the Mayor and city officials acknowledge that the company is entitled to pay for the water furnished, they contend that under the circumstances $43 a million gallons is exorbitant.

GOOD ROADS CONGRESS.

General Roy Stone of the Board of Inquiry of Good Roads of the Agricultural Department, Washington, D. C., was elected permanent president, Feb. 3, at the National Good Roads Congress held at Orlando, Fla; F. W. Merrin, of Florida, first vice-president; D. H. Baker, of Florida, second vice-president; D. T. Gerow, Florida, third vice-president; T. J. Appleyard, Florida, secretary. The committee on program, composed of S. V. Pickens of North Carolina, Charles Copelin of Michigan and J. T. Fellingen and W. L. Palmer of Florida, suggested the agitation of legislation, co-operation in road building, discussion of the best methods and meaterials for construction, and the best methods of arousing public interest and educating the public mind. The matter of proposed legislation was referred to a committee on resolutions, which was appointed, consisting of W. D. Chipley and W. M. Bennett of Florida, W. E. Anderson of Virginia and J. B. T. Tupper of the District of Columbia. A series of resolutions favoring the enactment of laws by which all classes and interests shall bear the burden of taxation for road improvement, the employment of convicts in road wark, placing the control of such work in the hands of boards of county commissioners; the creation of the office of county engineer; authorizing counties to issue bonds for road improvements upon a vote of three-fifths of the freeholders of such county; allowing a county or city to hire its convicts to another county under proper conditions; providing for the appointment of a state highway commission to superintend the distribution and expenditure of the state road fund, and state aid not to exceed one-third the cost of such permanent improvements, the remainder to be borne by the county or divided between the county and the people directly interested.

STREET PAVING IN SMALLER CITIES.

Desiring some information regarding street paving, Linus V. Clawson, president of the Board of Sewerage, Hamilton, O., caused letters to be sent to the city engineers of twenty-five cities, ranging in population, according to census of 1890, from 32,000 down to 21,000. The information asked was: "With what material are your streets paved, and how long since the paving was done? If asphalt, what kind and by whom put down? What length of guarantee was given and what is your experience in having repairs made? If brick, what make and how laid? What kind of guarantee and how satisfactory have you found same? What did your paving cost per square yard?"

Up to February 9 Mr. Clawson had received twenty-one answers from the twenty-five letters sent out. Of these eighteen contained information concerning brick pavements, five of sheet asphalt, eight of stone or granite and two of block asphalt. A condensed statement of the information given is as follows:

Springfield, Ohio.—32,000 population. Has 114,856 square yards brick pavement; cost $235,316.89—$2.05 per square yard; 14,855 square yards Medina stone pavement; cost $65,569.32—$4.68 per square yard; 297 square yards cedar block, cost $594.00—$2.00 per square yard. Five-year guarantee on all brick and stone pavements. Stone has been down 8 years and brick from 1 year to 7 years, all giving good satisfaction. Repairs have cost but little as yet.

Springfield, Ill.—24,800 population. Streets originally paved with cedar blocks, which were not satisfactory. All street improvements are now made with brick laid on 6 inch concrete foundation. No guarantee required, for if good work is done will last from 15 to 40 years according to traffic. During past season cost has been for reconstructing old block pavement (which saved in grading) $1.00 per square yard complete.

Chattanooga, Tenn.—29,000 population. 2 45-100 miles of sheet asphalt all laid by Warren-Scharf Co., on 6 inch concrete foundation with 2½ inches of asphalt surface. Five blocks of which were paved in 1888 at $2.85 per square yard with 5 year guarantee. Since guarantee expired $750 have been spent on said 5 blocks and extensive repairs will be required this year and probably in two or three years will call for complete renewal of asphalt surface. 4 miles of brick pavements, the oldest of which has been down 6 years. Bricks made at Robbins, Tenn. 5 year guarantee and cost $2.30 per square yard on 6 inch concrete foundation. No repairs and so far have proved quite satisfactory. One mile of block asphalt down 6 years has not worn with uniformity and therefore presents man irregularities of surface.

Pawtucket, R. I.—27,500 population. Has 97,155 square yards granite block, 1,965 square yards brick, 919 square yards asphalt. Brick laid 1892 of Barrington brick on six-inch concrete foundations with two-inch cushion of sand joints filled with pitch, cost $2.50 per esquare yard. This was laid on a grade of 5 per cent. and has not been as satisfactory

as if laid on a level surface. Asphalt of Sicilian and German rock laid by Boston Asphalt Company in 1893 under a five-year guarantee is in perfect condition. Has had no repairs. Cost $3.15 per square yard.

Birmingham, Ala. — 26,000 population. Granite blocks laid on broken stone cost $2.65 per square yard, and macadamized streets.

Muskegon, Mich.—22,600 population. Consider brick the best and cheapest pavement. Costs from $1.29 to $1.69, according to foundation and filling.

Elmira, N. Y.—28,000 population. Has wood, stone, brick and asphalt streets. Asphalt laid in 1895 under ten-year guarantee. Cost, $2.89. No repairs. Medina block cost $2.87; granite block cost $2.77½; Clearfield brick cost $1.74; United States brick cost $1.80. No expression as to which is most satisfactory.

Wichita, Kas.—23,700 population. Greater part is asphalt laid by Barber Asphalt Company. Has been in use six years and is generally in good repair. Cost, $2.80 per square yard with five-year guarantee and next five years city to pay contractor 10c per square yard for maintenance. Have five or six blocks of brick pavement laid six years ago of Atchison vitrified brick that is now in good condition with no cost for repairs. First cost, $2.45 per square yard on concrete foundation. Consider brick by far the most economical paving, as money is not sent away, but is put into circulation among those who have it to pay.

Davenport, Ia.—25,000 population. Vitrified brick. Principally from Galesburg, Ill. Began paving in 1889 and up to Jan. 1, 1897, have fifteen miles of brick pavement. Contractor guaranteed for two years, which we have found satisfactory. Cost in 1896, $1.24 per square yard for best Galesburg brick laid on five-inch concrete. Use a fifteen-ton steam roller for rolling foundation.

Haverhill, Mass.—27,300 population. Macadam costs $1.00 per square yard and the granite block $1.75 per square yard, using blocks twenty-two to square yard. No expression as to merits of material.

Joliet, Ill.—27,400 population. Have no asphalt pavement. Have about five miles of brick. Contractor to keep streets in good repair for one year. Five per cent. of cost retained by city. Streator, Ill., brick, cost $1.24 per square yard; Galesburg, Ill., brick cost $1.35 per square yard; Hallwood block, Zanesville, O., cost $1.25 per square yard. Above prices include four-inch concrete foundation, but do not include curb or excavation. Galesburg brick gives best satisfaction here, but Hallwood block is also standing wear and frost in good shape.

Canton, O.—26,000 population. Pavements of brick laid as follows:

1. Graded to a sub-grade fourteen inches below full grade.

2. Sub-grade rolled with thirteen-ton steam roller.

3. Broken limestone foundation in place, rolled with steam roller so when solidified it is eight inches in depth.

4. Cushion coat of two inches sharp sand placed over the stone and surfaced to a form parallel with the finished surface of the pavement.

5. Pavement of shale brick or block, wire cut and repressed are then laid in straight rows, from curb to curb, rammed and rolled with a five-ton roller until to a firm bearing.

6. Joint filler of pitch or cement grout used to fill all joints.

7. Surface covered with half inch sand to protect filler until thoroughly dry. Costs from 92 cents to $1.20 per square yard. People well satisfied with brick as paving material. Consider it fully as durable as asphalt, if not more so. First cost is much less as is also the repairs. Not so slippery as asphalt.

Quincy, Ill.—Thirty-one thousand population. Have about twenty miles of brick paving, but no asphalt. First paving was put down double course and cost $1.75 per square yard. Later work has been single course. Galesburg brick cost $1.10 per square yard, without guarantee, and has proven satisfactory.

Altoona, Pa.—Thirty thousand population. Have put down since 1888, 132,552 square yards of paving at a cost of $369,667.61. Of the above 67,712 square yards are sheet asphalt, most of which was put down in 1889 and 1890 at a cost of $3 per square yard, by the Barber Asphalt Company, two and one-half inches of surface on six inches concrete, price in 1895 with two-inch surface on six inches concrete, $2.50 per square yard by same company, all under five years' guarantee. Has cost city no repairs as yet. Some cracks are showing on most of the sheet asphalt streets and where water stands in the gutters there are signs of rotting, but such places are few. On the whole, sheet asphalt is proving to be a very satisfactory pavement. Of block asphalt we have 38,129 square yards on six-inch concrete foundation. Cost from $2.50 to $3.42. A fair price now will probably be $3 per square yard. This block was put down in 1888-89-90 and is in excellent condition, except where laid over trenches which have settled. Where this has occurred the blocks cannot be taken up and relaid satisfactorily. The best way to repair such places is to fill the depressions with sheet asphalt. Of stone block we have 14,214 square yards. Cost on six inches concrete, $3 to $3.10 per square yard. This is too rough and noisy. No more being liad. Of brick we have 10,919 square yards, most of which was laid in 1890 (3,700 yards in 1896). Cost last year $1.89 to $2 per square yard on six-inch concrete foundation. All brick paving in good condition and has cost nothing for repairs.

Akron, O.—Twenty-seven thousand seven hundred population. Have fifteen miles of brick pavement. The first laid seven years ago, also have three miles of Warren and Medina stone. Have no asphalt. No guarantee required. Final acceptance of work when finished relieves contractor. Think this gives us cheaper and better pavements. There has not been any repairs to our brick pavements since laid. All our brick pavements have been eminently satisfactory. Cost in last two years averages about $1 per square yard, curb not included. Brick are laid on a foundation of furnace slag (a waste material from iron furnaces), eight inchees deep thoroughly rolled and covered with a cushion of two inches of sharp sand.

Rockford, Ill.—Twenty-five thousand population. Have streets paved as follows:

Cedar block, 10,121 square yards laid 1889, 1890 and 1891. Plank foundation cost $1.08 per square yard; 1,720 square yards, same on rubble foundation, laid in 1892, cost $1.37 per square ward. Brick, 4,580 square yards, laid 1891, single course; 5,200 square yards, laid 1891, double course. Single course cost $1.37 and double course $1.75. All cedar blocks laid in 1891 will have to be replaced this year, for which purpose Galesburg brick will probably be used.

Dubuque, Ia.—Thirty thousand population. We have 3 6-10 miles of brick and about sixty miles of macadamized streets. No guarantee required. Use Galesburg, Ill., and Des Moines, Ia., brick on concrete foundation, with sand cushion, one course brick on edge with sand filling. Gives very good satisfaction. Costs on the average about $1.23 per square yard.

Racine, Wis.—Twenty-one thousand population. Streets paved with stone, cedar block and brick. Guarantee none. Have been done from one to five years. Advise brick on concrete foundation, with tar or asphalt filler. Cost of same from $1.20 to $1.60 per square yard.

Council Bluffs, Ia.—Twenty-one thousand three hundred population. Have eleven miles of cedar block, 2.38 miles of granite and 5.63 miles brick. Guarantees given only on brick laid in the last few years. The vital points in a brick pavement are a good foundation and a good brick. Poor brick, poor pavement. Cost not given.

Macon, Ga.—Twenty-two thousand six hundred population. Like Hamilton. Making an effort to pave. Bonds not placed yet. Material not decided upon.

PERMITS TO CUT INTO PAVED STREETS.

It has been customary, in Kansas City, Mo., for gas companies, telegraph companies, telephone companies, plumbers, etc., to obtain permits for opening paved streets from the superintendent of streets. The Board of Public Works has ruled that hereafter the superintendent may only issue a permit if the application is accompanied by the written consent of the contractor who paved the street or the bondsmen on the maintenance bond. The companies and plumbers are strenuously objecting to the ruling.

APPEAL IN THE AVERILL-BARBER LITIGATION.

An appeal has been taken to the Supreme Court of New York, by Amzi L. Barber and others, including the Barber Asphalt Paving Company, from a judgment of $476,000 obtained by Gen. William W. Averill. This is a new step in the prolonged litigation between these parties which has heretofore been mentioned in this magazine. Mr. Barber and Gen. Averill were associated together in the American Asphalt Company prior to 1881, when the corporation practically went out of existence, and in 1883 the Barber Asphalt Paving Company was organized with Mr. Barber as its president and one of its principal stockholders. An interest in the asphalt patents was claimed soon afterward by Gen. Averill, who began suit to recover profits made in laying asphalt pavements. The great point in contention in the action was for an inspection of the Barber Asphalt Paving Company's books. In deciding this point the general term of the Supreme Court said:

"Whatever might have been the propriety of having the books of the Barber Asphalt Company before the referee had the case remained as originally entered by the learned judge who tried the case, that decree having been reversed so far as the company was concerned, and the action dismissed as to it, the only question remaining to be investigated by the referee was the profits of Barber, McLain and Langdon, made by means of the De Smedt patents of either of the reissues thereof. With this question the Barber Asphalt Company had absolutely nothing to do, and the secrets of their business should not be brought into a controversy between the plaintiff and outside parties; and the question as to what contract it had made or what profits it had realized, was of no importance whatever in the investigation of the profits of the defendants therein named. We think a subpoena of the description issued in this case was, under the circumstances, oppressive in the extreme, and was a perversion of the process of the law. The plaintiff having been adjudged to have no cause of action or right to inquire into the methods of business or profits of the Barber Asphalt Company, an inspection of its books could have been sought only for the purpose of discovering the business of the company in which the plaintiff had no interest."

After this decision was rendered and after the company had been absolved from liability, General Averill claimed to have found that in the city of Buffalo contracts for laying asphalt pavements had been made in the name of Mr. Barber. The Barber Asphalt Paving company claimed that it was really doing all the work and receiving all the proceeds, and that Mr. Barber was but a nominal party in the transaction. The contracts were introduced, however, in evidence before the referee, who held that Mr. Barber should be charged with the profits on the entire work. The patents involved related only to the asphalt surface, but it is contended that Mr. Barber was charged with grading, curbing and concrete foundation, and this is the judgment from which the appeal is taken.

A BILL TO LEGALIZE THE CLAIMS OF CALIFORNIA CONTRACTORS.

A bill introduced in the California Legislature proposing to legalize claims for street improvement work done within two years

without fully complying with the Vrooman act has met with strong opposition. The Board of Supervisors in San Francisco, it has been held by the courts, have proceeded illegally with a number of contracts, and this bill, if passed, would relieve the companies who have done the work from losses amounting in the aggregate to about $200,000, but the public opposition is such that it seems improbable that it will pass

TRINIDAD'S CENTENNIAL CELEBRATION.

The one hundredth anniversary of its existence as a British colony was celebrated at Port of Spain, Island of Trinidad, February 15-20, and in commemoration of the four hundredth anniversary of its discovery by Columbus, which was thought to coincide nearly enough, the celebration was made a double one. Columbus landed on the island late in 1498, and in February, 1791, the British forces, under Sir Ralph Abercrombie and Admiral Parker, captured it from its Spanish rulers. The island of Trinidad has an area of 1,750 square miles, and is separated from the mainland of Venezuela by the Gulf of Paria and the narrow straits to the north and south, known respectively as the Boca del Drago, or Dragon's Mouth, and the Boca del Sierpe, or Mouth of the Serpent. Port of Spain, which is its capital and chief city, is said to be in many respects equal, and in some superior, to many European and American towns of the same size. The legislative Council of the Island appropriated $17,000 for the purpose of celebrating its first centennary. The celebrated Pitch Lake, which yields, practically, an inexhaustible supply of the asphalt so largely used for paving purposes in the United States, is one of the natural curiosities of Trinidad, and one of its most important sources of revenue, as the government levies a royalty on its export which gives a revenue of about $40,000 a year.

STREET CLEANING IN PHILADELPHIA.

Recent agitation in Philadelphia in favor of cleaning the streets as thoroughly as the work is done in New York, caused the Director of Public Works, Thomas M. Thompson, to make a statement regarding the comparisons between the two cities. "With the money at our disposal," he said, "I think the streets of Philadelphia can compare favorably with those of New York, excepting during a couple of months in the winter season, when the bulk of our trouble arises. If we had antything like the amount of money to spend that New York has we would keep our streets as clean as they do there. Col. Waring has $3,000,000 a year to do the work; give me but $2,000,000 and I promise you there would be no complaint. We haven't got the money, and to get it would mean an increased tax rate, a matter which is not generally taken into consideration. Suppose that, in order to get clean streets, we make an increase of 15 cents in the hundred in our assessments, what would property-owners say? I am inclined to believe that they would rather let the streets remain as they are. New York's tax rate is not so much higher than ours, but they get a tax from personal property as well as real estate, whereas we simply tax real estate. New York obtains as much revenue from personal property alone as we get from all our real estate. The state collects the personal property tax in this city."

"Do you not think it would be advisable to abolish the contract system here, as has been done in New York, and put the whole matter of cleaning the streets under the direct supervision of the city?"

"Yes, I can see some advantage in doing so," said the Director, "but, at the same time some disadvantage. The plan was tried here once, at a time when Mr. Baldwin was at the head of the Street Cleaning Department, but corruption prevailed in the management of affairs to such an extent that the system was by no means successful. That was before the Bullitt bill charter went into operation."

PASSING OF THE COBBLESTONE IN BROOKLYN.

In his annual report a year ago Mr. N. P. Lewis, engineer in charge of street construction and maintenance in Brooklyn, deplored the continuance of cobblestone paving in his city. In his last report, however, he says: "A keen interest has been developed in improved pavements, and petitions for repaving cobblestone streets with asphalt or granite are presented to the common council at nearly every meeting. This is in marked contrast to the indifference of our people to well paved streets, which was noted in last year's report. There has been a decided change in sentiment, caused, doubtless, by object lessons, which have been furnished, and the conviction that the people are getting excellent work done at lower prices than are being paid elsewhere."

Mr. Lewis says that the use of macadam for residence streets in outlying wards seems to be growing in favor, and he adds:

"If this macadam is well laid to a depth of not less than eight inches it will furnish a good foundation for an asphalt or brick pavement when these streets are permanently improved, and I therefore think that this work should be encouraged. It will be necessary, however, even with the mileage of macadamized roads, which we now have, to devise some intelligent system of supervision and maintenance for them, and a force should be organized for this express purpose. This force should be permanent and composed only of the most competent men and those especially qualified for this kind of work. As the cost of maintaining macadamized streets in proper condition is very great if subjected to any considerable traffic, such improvements should be confined to streets having very little travel and to the undeveloped sections of the outlying wards."

Commenting on the various kinds of pavement in use in Buffalo Mr. Lewis says: "As to the relative merits and ultimate economy of asphalt and vitrified brick for street paving, our limited experience with the latter tends to a verdict in favor of asphalt, which is unquestionably the best material now available for paving a residence street. Brick is very largely used in the smaller western cities because it is cheaper than asphalt, and the favor in which it is held there is doubtless due to the fact that the traffic is much lighter, and that the streets in most cases are not cleaned, so that the pavements are subjected to very little wear and the instances reported of brick pavements which have been in use for a dozen years and are still in good condition are thus explained."

THE OFFICE FORMS OF THE PEORIA WATER WORKS COMPANY.

To the Editor of Municipal Engineering:

I have received your esteemed favor of the 2nd inst., notifying me of your committee's award, and have also read with much interest the report of the committee as published in your February issue.

Please allow me to say that I think the criticism of our forms on the ground that they are somewhat too voluminous would be entirely justified for almost any other plant but ours, and may be justly applied, though to a much less extent, even to ours. It so happens that our legal situation here has rendered necessary considerable elaboration of details in some of the forms, especially in the applications, permits and special contracts; and we have lately been trying to see just where we might save a little ink, paper and storage space.

We have so far not succeeded in pruning to any extent. We find it hard to discard any of the verbiage, because our experience shows that while most of it is rarely needed, it all may be needed, and badly needed, at some time. It is probable that acting on the valued criticisms of your committee, we may be able to reduce the number or size of some of our other forms, and if so, we shall be glad to do so.

Mr. Ringness, who will share in some way in the prize, desires me to offer his thanks, with my own, for your generosity.

I sincerely trust that your liberality and enterprise may be the means of doing much for the general improvement of water works forms of record and of materially assisting water works men in the conduct of their business. If this be the result, I am sure you will feel abundantly rewarded.

Yours very truly,

DABNEY H. MAURY, JR.

Peoria, February 5.

A CORRECTION.

To the Editor of Municipal Engineering:

In your February issue you have a statement concerning an investigation of the Jefferson avenue paving at Detroit, which contains several injurious errors which we trust you will correct in your next issue. The result of the investigation made by the committee showed only one place where the concrete measured as low as 4¼ inches. The rest of the tests showed from 4¾ to 7⅝ inches, an average of 5 5-16 for all the tests made. Furthermore, the Talbot Paving Company did not have that contract. The contractor was J. H. Talbot.

THE TALBOT PAVING CO.,
By John F. Talbot, President.

Chicago, Feb. 1.

RECENT MEETINGS.

The Douglas County Road Improvement League held a convention in Omaha, Neb., Feb. 9. The program included addresses by the president, G. W. Williams, G. W. Whitmore of Valley, Maj. D. H. Wheeler of the City Council and L. W. Fitch and Walter G. Clarke of the League of American Wheelmen. Papers were read by G. W. Hervey of the Douglas County Agriculaural Society, J. E. Ebersole of the League of American Wheelmen, Commissioner Thomas Hoctor, Charles Grau of Bennington, Andrew Rosewater, ex-City Engineer, and Otto Dorner of Milwaukee.

The Illinois Society of Engineers and Surveyors held its annual meeting January 27, 28 and 29, at Springfield, Ill.

The report of the committee on "Land

and City Surveying" was presented by D. L. Braucher, Chairman. This report included a very carefully prepared paper by Z. A. Enos of Springfield, which gives a resume of the United States laws with reference to government surveys, and a logical method of interpreting the laws with reference to resurveys and subdivisions.

The discussion of "Riparian Ownership of Accretions" was read by Mr. S. S. Greeley of Chicago. Much interesting data was introduced into this discussion.

The report of the committee on "Licensing Surveyors" was submitted by Mr. S. S. Greeley, Chairman. After a discussion of the report a special committee was appointed, with instructions to draft a bill which would provide for the licensing of land surveyors, and at the same time introduce features into the present laws which would give the office of county surveyor in the state of Illinois more recognition and authority.

A. N. Talbot, Professor of Municipal Engineering, University of Illinois, presented a paper on "The Subsidence Process in Sewage Disposal." In this paper he described the plant and method of operating same now in use at Urbana, Ill.; also the proposed system for Champaign and Charleston, Ill.

Following this paper was a discussion on the proper methods for the "Disposal of Sewage of Communities Having no Large Water Sources," and the "Utility of Intercepting and Overflow Sewers."

The report of the committee on sanitary legislation was submitted by Mr. Jacob Harman, Mr. D. W. Mead, the Chairman, being absent. This report included a draft of the bill which had been prepared by the joint committee of engineers and physicians. This bill provides that the State Board of Health shall be given supervision and control over the water supplies and sewerage of the State, and said Board shall be provided with a consulting sanitary engineer. It also provides that the engineer referred to shall be elected by the Board, from one of three persons to be nominated by the Illinois Society of Engineers and Surveyors. The bill was approved by the Society, with the exception of that clause of section 8 which provides that the Society shall make the nomination of the engineer. It was the general opinion of the members that the State Board of Health should not be deprived of the right to name its own officers.

The report of the Water Works Committee was submitted by Mr. Dabney H. Maury, jr., Chairman; this report included statistics from seventy-five or eighty of the principal water works systems throughout the State of Illinois.

Following this report was a carefully prepared paper on "Test of a High Duty Pumping Plant Under Ordinary Working Conditions," by Mr. Dabney H. Maury, jr. This paper gave the results of a test of the Peoria water works pumping plant and contains much valuable information.

Prof. A. N. Talbot, chairman of the committee on Paving Brick Specifications, made a verbal report, in which he stated that the committee had not completed the tests which it had inaugurated, but that he would be able to submit a written report in time for publication.

The reports of the committees on Land Drainage, Public Highways and Weights and Measures were submitted by the chairmen of those committees.

A paper was presented by J. E. Miller, describing a new form of hard road, which has been constructed near Monmouth, Illinois, consisting of brick and macadam combined. Mr. S. S. Greeley of Chicago presented data with reference to House Bill 7251, Fifth-fourth Congress, which provides for the adoption by the United States of the international system of weights and measures. The Society indorsed the adoption of the metric system, and authorized the publication of conversion tables.

"The Streams of Illinois and Their Future Development" was ably discussed by Mr. E. J. Ward, who submitted stereopticon views of the work on the Chicago Drainage Canal.

Following the paper by Mr. Ward, the Hon. Lyman E. Cooley, Chicago, addressed the Society with reference to "Inland Waterways of Illinois, and the United States in General."

The report of the committee on Instruments, Blanks and Records, by W. A. Darling, Chairman, gave the methods of various members of the profession with reference to filing and indexing office records and other information.

Papers were also presented on "Rapid Computation," by M. S. Ketchum, and "A Concrete Arch," by Charles H. Nicolet.

The officers elected for the ensuing year were: President, Charles C. Stowell, Rockford, Illinois; vice-president, E. J. Chamberlin, Pittsfield; recording secretary, P. C. Knight, Pontiac, Ill.; executive secretary and treasurer, Jacob A. Harman, Peoria, Ill.; trustees, A. Lagron, Freeport, Ill.; Charles Rickard, Springfield, Ill., and W. D. Pence, Champaign, Ill.

The next annual convention will be held in Peoria, Ill., the last week in January.

PERSONAL.

David N. Cook has been elected street commissioner at Salem, Mass.

William Berri has been appointed president of the bridge trustees at Brooklyn, N. Y.

Henry S. Haines of Camden, N. J., has been elected engineer of the Sea Side Park Company.

George M. Edwards has been elected secretary of the Water Works Commission at Cincinnati, O.

J. E. Casey has been elected superintendent of the water works and electric plant at Barnsville, Ia.

Charles W. Hardy, ex-superintendent of water works at Staunton, Va., died at Hinton, W. Va., Jan. 29.

Howard Knowles, Galesburg, Ill., has been elected president of the Peoria Water Company, Peoria, Ill.

J. H. Nelson, civil engineer, has opened an office in the Lanmer County Bank Building, Loveland, Colo.

C. M. Duke has been appointed chief engineer and superintendent of the water and light plant at Paris, Tenn.

Charles A. Davis and J. I. Williams have formed a business partnership as civil engineers at Lancaster, N. H.

Charles Swan, for several years water commissioner at Trenton, N. J., died in that city Jan. 28, aged sixty-five years.

Prof. Henry L. Whiting of the Massachusetts Topograhphical Survey Commission, died at West Tisbury, Mass., Feb. 4.

Rudolph Hering, M. Am. Soc. C. E., has been engaged to examine and report upon the sewerage and drainage of Ottawa, Ontario.

Bernard Bienenfeld delivered a lecture at the Mechanics' Institute Library, San Francisco, Cal., Feb. 13, upon the "Origin and History of Asphalt."

C. E. Chandler, civil engineer and surveyor, of Norwich, Conn., has formed a partnership with Shepard B. Palmer, who has been employed in his office for several years.

Edson M. Ellinwood, who has for five years served as superintendent of the Clyde Water Works company, Clyde, N. Y., has resigned his position, his resignation to take place March 1.

Frank L. Northrop, superintendent of the Milford Water Company, Milford, Mass., has accepted a position as New England representative of the Union Water Company of Worcester, Mass.

John Birkinbine, past president of the American Institute of Mining Engineers, has been elected president of the Franklin Institute of Philadelphia, to succeed Joseph M. Wilson, who declined re-election.

Charles Jacobson, engineer of the Passaic Valley Sewage Commission and who served several years as engineer of the old Newark Aqueduct Board, and the Board of Street and Water Commissioners of Jersey City, N. J., died at Roseville, N. J., Feb. 11.

Nicholas D. Hill, Jr., has been elected chief engineer of the Water Board at Baltimore, Md., to succeed Mayor William L. Kenley, who resigned. Mayor McKenley, who has been connected with the Water Board for 41 years, has been appointed consulting engineer to the board.

Through a typographical error, which it is better to correct now than never, the name of Mr. E. Kuichling of Rochester, N. Y., appeared in an editorial article in our last number as Knichling. Among water works men Mr. Kuichling is quite well enough known not to lose his identity by this error.

In condensing long and valuable reports received from Newark, N. J., much that was in the report of the General Superintendent, J. C. Mundy, was credited by mistake to the report of the City Engineer, who also had furnished statistics which naturally when treating of the same parts of a similar subject agreed with those of Superintendent Mundy.

The Board of Commissioners of the Windsor (Ont.) Water Works Company at their last meeting adopted a resolution of thanks to Mr. F. H. Macpherson, their auditor, and also commended his complete and satisfactory system of accounts, which, after thorough test, they believed to be the most suitable for their purposes. Mr. Macpherson received the award of the third prize in the Municipal Engineering competition on water works records. In a letter to Municipal Engineering, under date of Feb. 11, he says: "Permit me to say that I highly appreciate the honor which I have had conferred upon me; let me also say that I shall always be pleased to furnish your magazine or any of its numerous readers with any further information in my power, with reference to the system of accounts introduced by me in the water works office of this city."

MACHINERY AND TRADE NOTES.

The purchase of a stone crusher is urged at Binghamton, N. Y.

Capitalists of Cleveland, O., will establish cement works in Branch county, Michigan.

The Ohio River Gravel Road company was incorporated at Indianapolis, Ind., Feb. 4.

James Green, St. Louis, Mo., contemplates establishing two clay pipe factories in Mexico.

The plant of the Royal Sewer Pipe Company, Toronto, O., will probably be offered for sale soon.

The purchase of a steam road roller has been advised for use on the highways at Yuba City, Cal.

The citizens of North Andover, Mass., contemplate appropriating $600 for the purchase of a road roller.

The city council, Belvidere, Ill., has directed the street and alley committee to purchase a street roller.

The Terre Haute Brick and Pipe Company, Terre Haute, Ind., contemplates erecting three additional kilns.

The Olive Hill Fire Brick Works, Ashland, O., contemplates building six new kilns and doubling their dryer capacity.

The purchase of a steam road roller for use on the streets is being discussed by the city authorities at Albion, N. Y.

The question of purchasing a steam road roller is being discussed by the council. J. C. Plumb and Councilman McCreery.

Bids are asked until March 8 for breaking rock in Raritan river, New Jersey. Maj. H. M. Adams, Army Building, New York City.

The city council, Halifax, N. S., is considering the question of purchasing a new stone crusher. Councilmen Wilson and Kerr.

The Galesburg Vitrified Brick company, Galesburg, Ill., has elected H. P. Wood president, and E. S. Gunnell, secretary and treasurer.

The Macomb Sewer Pipe company, Macomb, Ill., has re-elected W. E. Boyne president, Wm. Frost, secretary; A. Eads, treasurer.

Charles Pauls has been elected president and W. H. Trout secretary and treasurer of the Canon Brick and Tile company, Canon City, Col.

The William Block Paving Company has been incorporated at San Francisco, Cal., by A. Wenzelberger, William Maris and Henry M. Whitely.

J. A. Harmon, Shawnee, Oklahoma, contemplates purchasing a full equipment of machinery for manufacturing fire, pressed and paving brick.

The Crown Cement, Lime & Brick Company, Baltimore, Md., has been incorporated by William Whitbridge, Henry C. Wagner and Morris Whitbridge.

The Star Fire Brick company, Sciotoville, O., has elected officers as follows: President, E. B. Green; vice-president, R. S. Towne; secretary, Addison Taylor.

Bids are asked until March 10 for supplying stone for building lock No. 5 on Cumberland river. Capt. John Biddle, United States Engineer, Nashville, Tenn.

A company is being organized in St. Louis, Mo., to manufacture building and paving brick. John P. Kaiser and the Gaffney Vitrified Pressed Brick Company are interested.

The Union Cement and Lime Company has been incorporated at Louisville, Ky., by R. A. Robinson, W. A. Robinson, J. W. E. Bayley and J. T. Cooper.

The Midvale Paving and Fire Brick Works, at Midvale, O., will, according to press reports, be purchased by the Labor Exchange and put into operation.

The Cleveland & Canton Brick Company has been incorporated at Canton, O., by Henry P. Belden, Joseph L. Highley, Peter Miller, Eckstein Case and Frank B. Many.

The superintendent of street cleaning, Chicago, Ill., has recommended the purchase of street cleaning machines at a cost of $20,000. Joseph Downey, Commissioner Public Works.

Henry R. Worthington was awarded the contract Feb. 8 by the Water Board, at Baltimore, Md., for two pumps of 17,500,000 gallons each, and one of 10,000,000 gallons, at $123,000.

The Galesburg Paving Brick Company has elected officers as follows: President, T. R. Willard; vice-president, F. H. Holmes; treasurer, W. E. Terry; secretary, C. T. Willard.

F. G. Lotterer, Fort Scott, Kas., contemplates purchasing about sixty-five double-deck dry cars, a dry pan, smooth rollers, tailings crusher and chain elevator cup conveyer with boot.

Plans have been adopted for a portable asphalt paving plant, which a local asphalt paving company in Providence, R. I., will build for work in other cities within convenient distance of Providence.

The New England Sanitary Product Company, Jersey City, N. J., has been incorporated to remove and destroy garbage, by David B. Martin, Clarence B. Kruger and Walter Peterson, Philadelphia, Pa.

The California Asphaltum Company, Pittsburg, Pa., is, according to press reports, preparing to put in a plant for refining asphaltum; estimated cost, $50,000. The company is represented by Dobbs & Booth.

The Clinton Cement Company has been incorporated by the following: F. N. Hoffstat, J. W. Friend, Allegheny, Pa.; X. L. W. Smith, Pittsburg; Y. Frank Park, Jr., Sharpsburg; F. N. Matthews, McKeesport.

An appropriation of $14,000 has been recommended to the council at Winnipeg, Manitoba, of which $10,000 is to be spent for crusher, derricks, engines, boilers, etc., and $4,000 for running expenses at the quarry.

The Union Sewer Pipe Company, Red Wing, Minn., has been formed, according to press reports, to represent the John H. Rich Sewer Pipe Works and the Red Wing Sewer Pipe Company. President, John H. Rich; secretary, C. E. Sheldon.

The Acme Automatic Sewer Trap Company, New York, has been incorporated by Philip F. Lenhart, P. Frederick Lenhart and Zachariah Latshaw of Brooklyn, William Godfrey of New York City and George C. Tranter of Port Richmond.

The State Line Sewer Pipe Works, East Palestine, O., has elected directors as follows: F. Gwinner, H. Laughlin, James Mullins, W. J. Mullins, R. Forbe Taggart, S. G. Graham and E. Ebberts. Fred Owesney and D. C. McCurdy of Steubenville, lessees of the works, will put the plant in operation March 1.

The Standard Sewer Pipe Company, Rochester, N. Y., has elected trustees as follows: Mathias Kondolf, Edward W. Peck, Charles W. Voshal, Frank N. Kondolf, Frank Taylor, J. Miller Kelly, William E. Verner, A. Vogt and Charles Rau.

The Alton Paving, Building and Fire Brick Company, Alton, Ill., has elected officers as follows: President, Edward Rodgers; secretary and treasurer, Eben Rogders. Trustees: William Eliot Smith, Baker Schiess, Dr. E. G. Lemen, Edward and H. P. Rodgers.

The Gilson Asphaltum Company, which has the contract for paving E. Nineteenth street, Kansas City, Mo., will erect a new paving plant at 20-22 Mayfield avenue. The structure will be of frame and the entire cost will be more than $16,000. The company expects to have the plant in operation by the middle of April.

The Good Roads Machinery Company, Kennett Square, Pa., has been formed, with William A. Lynch as president and S. Jones Phillips as treasurer and manager, to sell the Aultman street sweepers, and the Champion road machine, rock crushers and road rollers, made by the American Road Machine Company, Kennett Square, Pa.

The Globe Bicycle Path company filed articles of incorporation, Jan. 21, at Denver, Col., to manufacture and sell a material, patent process, for use in constructing and repairing bicycle tracks. The incorporators are John B. Hansler, George W. Stoll and W. L. H. June of New York. The offices will be located in New York City and Denver, Col.

The stockholders of the Capital City Vitrified Brick and Paving company, Topeka, Kas., elected directors, Jan. 12, as follows: T. A. Beck, D. W. Mulvane, E. F. E. Wear, F. P. Edson, F. H. Kingsland, M. Weightman and Willis Edson. The directors elected officers as follows: President, T. A. Beck; vice-president, D. W. Mulvane; secretary and treasurer, Willis Edson.

The supreme court handed down a decision Feb. 9 in the case of Winters, Parsons & Boomer against the state of Idaho for extra work done on the Lemhi and Custer county divisions of the state wagon road. The court finds the contractors are entitled to $6,744.25, and the Legislature is recommended to make an appropriation for the purpose of settling the claim.

Bids were received by the Board of Public Works at Indianapolis, Ind., Feb. 15, for a steam roller as follows: O. S. Kelley Co., ten tons, $3,000; twelve tons, $3,200; Pitts agricultural Works, ten tons, $3,000; twelve tons, $3,200; fifteen tons, $3,500; Enterprise Manufacturing company, ten tons, $2,900; twelve tons, $3,150; fifteen tons, $3,300; Harrisburg Foundry and Machine Works, ten tons, $3,100; twelve tons, $3,400; fifteen tons, $3,600. The contract was awarded to the O. S. Kelly Co. for a twelve-ton roller at $3,200.

The annual meeting of the Purington Paving Brick Company was held January 26 at Galesburg, Ill., and officers elected as follows: President and treasurer, D. V. Purington; secretary, C. H. Chamberlain; directors, D. V. Purington, George Prussing, S. S. Kimball, Chicago; O. F. Price, Will Phillips, Frank Matteson and W. S. Purington. The reports rendered at the meeting showed that, notwithstanding the hard times, the business of the company during the last year was quite an improvement over that of the previous year. Work will be resumed the 1st of March and both yards will be run during the year.

Henry R. Worthington has just been awarded a contract by the city of Chicago covering six vertical triple expansion direct-acting high duty pumping engines, each of twenty million gallons daily capacity. This contract amounts to $437,600.00, and is the largest contract for water works pumping machinery ever placed in this country. The above six engines each have a daily capacity of twenty million gallons against a head of 150 feet, and will be supplied with steam at a pressure of 140 pounds to the square inch. The engines will be each of 530 horse-power. This company is also building three vertical triple expansion direct-acting high duty pumping engines for the city of Brooklyn, N. Y., under a contract amounting to $385,000. These engines each have a daily capacity of twenty million gallons to be delivered against a head of 168 feet, and the steam will be supplied at a pressure of 135 pounds to the square inch, each engine being of 600 horse-power.

A handsomely printed and illustrated special catalogue has been issued by Henry R. Worthington, describing the Worthington cooling tower, a water saving device recently patented and now being placed on the market. It is important to ice manufacturers and users of refrigerating machinery. A combination with condensers giving a vacuum without a water supply is an interesting feature, full details of which are set forth in the catalogue.

The Colliery Engineer Co., Scranton, Pa., proprietors of The International Correspondence Schools, announce that commencing with the February issue the name of the journal, Home Study, which they publish, will be changed to Home Study Magazine; the page will be reduced to magazine size but the number of pages will be doubled. The articles relating to particular branches of industrial science will be grouped in separate issues. Articles relating to steam engineering will be published in the February and August issues; those on plumbing, heating and ventilation, in the March and September issues; those on architecture, in the April and October issues; those on civil engineering, in the May and November issues; those on electrical engineering, in the June and December issues; and those on mechanical engineering, in the July and January issues. Each issue will contain other articles, but as a rule, the general reading portion will consist principally of articles on some particular technical subject. Each issue will contain a drawing plate with instructions for drawing it, and an effort will be made to adapt the plate to the subject treated in the issue in which it appears. These plates will be of great assistance to anyone who desires to learn drawing and will be valuable for reference. The subscription price is $1.50 a year, but subscriptions will be accepted at thirty cents for any of the two-number editions.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Buffalo, N. Y.—The contract for repaving Lower Terrace has been awarded to Michael Newell for $9,150.

Bellevue, Pa.—The contract for paving, grading and curbing Euclid avenue was awarded Feb. 2 to A. V. Purnell for $7,740.

Baltimore, Md.—The new commissioners for opening streets, Hiram Taylor, John Glen and Louis Hoffman, assumed their duties Feb. 16.

New Castle, Pa.—State Senator Wm. M. Brown of this city has introduced a bill in the senate to legalize all the street and sidewalk paving that has been done by cities of the third class.

Kittanning, Pa.—The citizens voted, Feb. 16, in favor of bonding for $5,000 for the purpose of resuming the paving of streets, which was begun last fall. Houston Bros. of Pittsburg have the contract.

Racine, Wis.—N. F. Reichert was the lowest bidder recently for street paving. His bids were as follows: Washington avenue, $12,178.50; State street, $3,536.14; Northwestern avenue, $6,985.40.

Santa Ana, Cal.—French & Reed of Los Angeles secured the contract for paving Fourth street, from Spurgeon to French, at 18 cents a square foot for paving, and 22½ cents a square foot for guttering.

Kansas City, Mo.—The Gilson asphaltum company of St. Louis has the contract for paving E. Nineteenth street, from Main to Tracy avenue. The company is erecting a paving plant at 20-22 Mayfield avenue.

Toledo, O.—The contract for constructing a stone road in West Toledo two and a quarter miles in length was awarded Feb 7 to Garrigan Bros. at $12.65 a square yard for macadamizing; total, $13,000.

Louisville, Ky.—The contract for resurfacing Kentucky street, between Third and Fourth, and Sixth street, between Oak and Ormsby, has been awarded to the Breckenridge asphalt company, but at what price could not be learned.

St. Charles, Mo.—The contract for grading and paving certain streets was awarded Feb. 15 to David Ryan of Alton, Ill., at $2.76 a front foot. The paving will be one course of brick on a concrete and sand foundation, and will cost from $20,000 to $25,-600.

Erie, Pa.—Paving contracts were awarded Feb. 1 as follows: Eleventh street, from Parade to East avenue, Mayer Bros., Canton Shale, Holloway repressed, $1.70 a square yard; Thirteenth street, from State to Peach, V. D. Eichenlaub, Park No. 1, vitried brick, $1.64 a square yard.

Kansas City, Mo.—The Parker-Washington Paving Company has been granted until March 20 in which to file its indemnity bond in connection with its contract for curbing, guttering and paving Broadway, from Sixteenth to Twenty-first-st. with asphalt.

Columbus, O.—Owing to a disagreement, Feb. 17, regarding an ordinance and advertisement for bids, which did not coincide, the Board of Public Works rejected the street paving bids received, owing to the fact that some of the contractors had been unintentionally misled, and that to award the contract under the conditions might prove dangerous.

Denver, Col.—Bids were received Feb. 10 for grading and curbing in Capitol Hill district No. 1 as follows: William Hayden, $144,300.80; Charles Connors, $151,826.60; J. M. O'Rourke, $157,826; Geddis & Seerie, $158,-702.20; Frank Anderson, $160,725.80. The contract, which was let to William Hayden, is one of the largest ever let in the west, and involves the placing of nearly 35 miles of sandstone curbing.

Denver, Col.—Bids were received Jan. 28 for paving Broadway, from Colfax to Ninth avenue, with asphalt, and the contract was awarded to the Colorado Paving Company at $2.61 a square yard for paving and 69 cents a lineal foot for curbing, or a total of $54,448.59. The other bidders were: Western Bermudez Company, paving $2.50 and curbing 76 cents; Hugh Murphy, Alcatraz asphalt, paving $2.34 and curbing 40 cents; F. O. Blake & Co., paving $2.62 and curbing 50 cents.

St. Louis, Mo.—The Board of Public Improvements awarded contracts, Feb. 16, for fourteen street and alley improvements. The most important contract was for paving Mallinckrodt street, from Main to First, with granite, which was awarded to H. Rueckling & Co., for $5,796. The Hill-O'Meara Construction Co. was awarded six contracts, H. Rueckling & Co. three, Michael Hanich two and Thomas Whelan, J. E. Perkinson and the Heman Construction Company one each.

Cleveland, O.—Bids were received Feb. 10 for improving seventeen streets, four of which were asphalt paving with a 5-year guarantee. The Warren-Scharf Asphalt Paving Company's bids on these streets were $2.69, $2.69, $2.52, $2.58; Columbia Construction Co., $2.25 $2.25, $2.30, $2.20; Brennan & Buettner, $2.30, $2.20, $2.30, $2.20. The price formerly paid by the city was from $2.65 to $2.90 a square yard. The Board of Control rejected the bids and hopes to get lower prices when they again advertise.

Syracuse, N. Y.—The contract for paving Westcott street, from Genesee to Croton, with asphaltina was awarded, Feb. 15, to W. J. Gillette. A temporary injunction was granted by Judge Ross, Feb. 17, however, restraining the city from entering into a contract with William J. Gillette on a complaint which alleges that asphaltina is not the material wanted. The bids were received Feb. 1 and ranged in prices from $30,215 to $40,425. Bids were received the same day for paving E. Genesee street and Waverly Place, but action was deferred.

Kansas City, Mo.—Competition in asphalt

and brick paving is proposed at Kansas City, Mo. The question is now being considered by Mayor Jones, City Engineer Wise, the Board of Public Works and the Public Improvements Committees of both houses of the council. At present property-owners' petitions for paving name the brand of asphalt wanted, thereby restricting the bidding to the company which can furnish that kind of asphalt. Mayor Jones says: "The idea is to declare certain brands of asphalt standard asphalt, which may be offered in bids on all asphalt pavement. The same plan is proposed as to brick pavement."

Hasbrouck Heights, N. J.—Special.—Bids were received Feb. 8 for the improvement of Kipp and Oak avenues as follows: David Bowden, Plainfield, N. J.—Kipp avenue: Excavation, 750 cubic yards, 25 cents; paving, 6,440 square yards, 68 cents; curb and gutters, 4,800 lineal feet, 24 cents; total, $5,718.70. James R. Toleson—Excavation, 25 cents; paving, 80 cents; curb and gutters, 18 cents; total, $6,203.50. Smith & Conover, Freehold, N. J.—Excavation, 21 cents; paving, 73 cents; curb and gutters, 31 cents; total, $6,346.70. Ryan & McGuire, Passaic, N. J.—Paving, $1.35; curb and gutters, 35 cents; total, $10,374. Oak Grove avenue: David Bowden—Excavation, 800 cubic yards, 25 cents; paving, 3,300 square yards, 65 cents; curb and gutters, 2,500 lineal feet, 24 cents; total, $2,945. Smith & Conover—Excavation, 24 cents; paving, 64 cents; curb and gutters, 31 cents; total, $3,079. James R. Toleson—Excavation, 25 cents; paving, 75 cents; curb and gutters, 18 cents; total, $3,125. Ryan & McGuire—Paving, $1.25, curb and gutters, 35 cents; total, $5,000. The contracts were awarded fo David Bowden of Plainfield. F. A. Dunham, C. E., of Plainfield, N. J., is engineer in charge of the work. The borough contemplates more work of the same character during the coming season.

Hamilton, O.—Bids were received Feb. 15 for paving High street with asphalt, blocks or vitrified brick as follows: Asphalt—Ohio Bermudez Co., Cincinnati, $2.38 a square yard; E. M. Ayres, Zanesville, California asphalt, $2.12; Kirchner & Folz, Cincinnati, Trinidad or Alcatraz asphalt, $1.65 each; Wilson & Strack, Cincinnati, $2.25. Asphalt blocks—M. Sullivan, Cincinnati, gravel foundation, $2.36; concrete foundation, $2.63; Wilson & Strack, gravel foundation $2.35; concrete foundation, $2.62; Edward Ryan, Springfield, gravel foundation, $2.57; concrete foundation, $2.77; John M. Durrough, Hamilton, gravel foundation, $2.83; concrete foundation, $3; B. D. Bartow, Hamilton, gravel foundation, $2; concrete foundation, $2.16; James M. McCloud, Columbus, gravel foundation, $2.34; concrete foundation, $2.55. Brick—James M. McCloud, under section No. 1, $1.38; section No. 2, $1.44; R. N. Andrews, Hamilton, No. 1 $1.28; No. 2, $1.26; M. G. Cain, Dayton, No. 1, $1.54; No. 2, $1.59, $1.63 and $1.68; Kirchner & Folz, Cincinnati, No. 1, $1.67, $1.74; No. 2, $1.60, $1.54; Ed Ryan, Springfield, No. 1 $1.49, $1.45, $1.75, $1.55; No. 2, $1.58, $1.59, $1.74 Folz & Dannenhauer, Indianapolis, No. 1, $1.56; No. 2, $1.56; John M. Durrough, Hamilton, No. 1, $1.44; No. 2, $1.46; Jerry M Quill, Cincinnati, No. 1, $1.61; No. 2, $1.54 $1.61, $1.64, $1.68; Harry Dickmeier, Cincinnati, No. 1, $1.79; No. 2, $1.84; M. Sullivan Cincinnati, No. 1 and 2, $1.60, $1.62, $1.53 each; Wilson & Strack, Cincinnati, No. 1, $1.65, $1.55; No. 2, $1.62, $1.68. The bids have been placed on file for consideration.

Scranton, Pa. — (Special.) — Joseph P. Phillips, City Engineer, says bids were received Feb. 18, for paving Mulberry street with asphalt on a 6-inch concrete base, as follows: Barber Asphalt Paving Company, New York City—Paving, Trinidad Lake asphalt, $2.52 a square yard; taking up old and relaying asphalt, $2.52 a square yard; taking up old and relaying brick paving, $1.75 a square yard; new curb, 56 cents a lineal foot; new curb with drain tile, 67 cents a lineal foot; circular curb, 90 cents a lineal foot; redressing and resetting old curb, 19 cents a lineal foot; straightening old curb, 10 cents a lineal foot; tile drain, 13 cents a lineal foot. Dunn Bros., Scranton, Pa.—Paving, $2.54 a square yard; taking up old and relaying asphalt, $2.58 a square yard; taking up old and relaying brick pavement, $1.60 a square yard; new curb, 58 cents a lineal foot; new curb with tile drain, 73 cents a lineal foot; circular curb, 92 cents a lineal foot; redressing and resetting old curb, 18 cents a lineal foot; resetting old curb, 15 cents a lineal foot; straightening old curb, 12 cents a lineal foot; tile drain, 16 cents a lineal foot. Columbia Construction Company, Syracuse, N. Y.—Paving, asphalt, from Dundonald deposit, near Point La Brea, Trinidad, $1.95 a square yard; taking up old and relaying asphalt pavement, $1.50 a square yard; taking up old and relaying brick pavement, 75 cents a square yard; new curb, 23 cents a lineal foot; circular, 48 cents a lineal foot; redressing and resetting old curb, 12 cents a lineal foot; resetting old curb, 5 cents a lineal foot; straightening old curb, 5 cents a lineal foot. August Robinson, Scranton, Pa.—Paving, genuine Trinidad asphalt from village of La Brea, Island of Trinidad, $2.10 a square yard; Pitch Lake asphalt, $2.43 a square yard; taking up old and relaying asphalt paving, $2.50 a square yard; taking up old and relaying brick pavement, $1.60 a square yard; new curb, 56 cents a lineal foot; new curb with tile drain, 70 cents a lineal foot; circular curb, 80 cents a lineal foot; redressing and resetting old curb, 16 cents a lineal foot; resetting old curb, 10 cents a lineal foot; straightening old curb, 10 cents a lineal foot; tile drain, 16 cents a lineal foot.

CONTEMPLATED WORK.

Clinton, Ill.—Street paving is being agitated.

Portsmouth, O.—Paving is proposed for E. Gallia-st.

Saginaw, Mich.—Brick paving is proposed for Wadsworth-st.

Utica, N. Y.—Upper Whitesboro-st. will be paved with asphalt.

Springfield, Mass.—Paving is contemplated for Byers and Federal-sts.

Leicester, Mass.—This town will be allowed another mile of state road.

Meridian, Miss.—About $50,000 will be expended in street improvements.

Kenosha, Wis.—Brick paving is contemplated for Prairie-ave. this spring.

Des Moines, Ia.—Bids will be advertised for brick paving in a large number of streets.

Rockford, Ill.—Brick paving is contem-

plated for S. Main-st., by the City Council.

Chicago, Ill.—Warren-ave., from Homan-ave. to Falls-st., will be paved with asphalt

Cincinnati, O.—Kinsey-ave., from Hunt to a line west of Waverly-ave., will be macadamized.

Hartford, S. D.—The Council contemplates ordering some street paving this spring.

Somerville, Mass.—An appropriation of $100,000 was made Feb. 11 for street improvements.

Athens, N. Y.—The Boro Council contemplates expending $14,000 in street paving this spring.

Chicopee, Mass.—Mayor Eldredge is considering a plan to borrow $90,000 for street improvements.

Easton, N. Y.—The Town Board has voted to build a new road by the Kidney creek this spring.

Rushville, Ind.—Brick paving is said to be contemplated for several streets. City Engineer Harkless.

Monmouth, Ill.—A proposition for the extension of the hard roads will be voted on in April.

Topeka, Kas.—Plans are being formulated by the Commercial Club for macadamizing several streets.

Kansas City, Mo.—Brick paving is recommended for portions of Thirtieth and Twenty-second streets.

Lancaster, O.—About 14,000 square yards of brick paving will be laid this year. John N. Wolfe, City Engineer.

Winona, Minn.—About 19,000 square yards of macadam will be laid on Broadway. George J. Heuston, City Engineer.

Newark, N. J.—An appropriation of $10,000 is urged for grading and curbing and $5,000 for sidewalks.

Corry, Pa.—About 20,000 square yards of brick paving is contemplated this year. Geo. D. Gilbert, City Engineer.

Urbana, Ill.—An ordinance for paving W. University-ave. and Romine-st. was passed Feb. 1. Mayor Hubbard.

West Chester, Pa.—A macadam road is being urged from this city to Phoenixville. County Commissioners.

Deposit, N. Y.—Brick paving is said to be contemplated for one of the principal streets in this town.

Milwaukee, Wis.—Petitions are said to be in circulation for asphalt and wooden block paving on Prospect-ave.

Detroit, Mich.—Commissioner Moreland has asked that nine streets be paved with brick, asphalt and cedar blocks.

Oswego, N. Y.—A petition has been presented to the department of public works for a macadam roadway in W. Second-st.

Quincy, Ill.—Brick and novaculite paving is proposed for nine streets this year. Commissioners Deaderick, Chatten and Harris.

Sullivan, Ind.—A petition has been circulated for the construction of about 75 miles of additional gravel roads in this county.

Syracuse, N. Y.—A petition will be circulated for paving Orange-st. from E. Genesee-st., several blocks south, with asphalt.

Pittsburg, Pa.—Ordinances have been favorably acted upon for grading, curbing and paving portions of Monongahela and Susquehanna streets and grading Burchfield avenue.

Scranton, Pa.—Joseph P. Phillips, City Engineer, is preparing specifications to be used in receiving bids for repairing asphalt pavements.

New Haven, Conn.—A. B. Hill, C. E., estimates the cost of grading Long Hill road, between this city and Woodbridge, at $6,000 or $7,000.

Brooklyn, N. Y.—Silliman Place and Quincy avenue will be paved with asphalt and eleven streets will be repaved with asphalt and granite blocks.

Council Bluffs, Ia.—Alderman Shubert has proposed that permanent roads of macadam and brick be built in all directions leading from the city.

St. Louis, Mo.—Petitions have been presented to the board of public improvements for about eighty street and alley openings and improvements.

Denver, Col.—It is probable that the residents of S. Broadway street will petition to have the paving extended from Ninth avenue to Alameda street.

Kansas City, Mo.—A petition has been circulated for the paving of Indiana avenue, from Twelfth street south to the city limits, with vitrified brick.

Atlanta, Ga.—A resolution has been adopted by the commissioners providing for the improvement of East Point and Peachtree roads by laying chert.

Cincinnati, O.—Resolutions have been adopted for paving St. Clair alley, from Sixth to Seventh, with asphalt, and Coleman and Spinning alleys with brick.

Madisonville, O.—An ordinance was passed by the council, Feb. 17, ordering the improvement of Tompkins avenue, from Peacock avenue to Water avenue.

Battle Creek, Mich.—About 1,000 feet of brick paving is proposed for Jefferson street. If the question passes the council it will then be voted on in April.

San Francisco, Cal.—The Board of Supervisors has been requested to grade, sewer, curb with granite and pave St. Joseph avenue, between Geary and Turk streets.

Wallisville, Tex.—An order has been adopted instructing County Judge W. B. Gordon to receive bids for grading all the first class roads in the county.

Augusta, Ga.—An ordinance has been signed by Mayor Young, directing that granite curbing be constructed on Twelfth street at a cost of 33 cents a lineal foot.

Minneapolis, Minn.—The residents of Superior avenue have presented a petition to the Board of County Commissioners asking that the thoroughfare be graveled.

Bartow, Fla.—The question of issuing $50,000 in bonds for macadamizing the roads for ten feet on each side of the center is being considered by the County Commissioners.

Baltimore, Md.—Ordinances have been passed appropriating $60,000 for repaving N. Caroline street with asphalt and $60,000 for repaving Eutaw street with Belgian block.

Macon, Ga.—An important question which is receiving consideration now is what material to use for paving the business section of the city. A suggestion has been made that whatever material is decided upon, whether vitrified brick or Belgian block, that streets contiguous for a square distant from the business section should be paved with macadam.

Rochester, N. Y.—A new ordinance has been prepared which provides for an asphalt roadway on State street, from Center to Jay. The first ordinance provided for Medina block paving.

Columbus, O.—An ordinance has been passed for asphalt, brick, stone block, or brick block pavement on Neil street, from Mt. Vernon avenue to Lafayette alley. John M. Doane, City Clerk.

Sea Side Park, N. J.—Henry S. Haines, Camden, N. J., has been elected engineer of the Sea Side Park Co., which contemplates opening, grading and graveling streets, building sewers, etc.

Clayton, Mo.—A petition has been presented to the county court asking that Delmar Boulevard be graded, macadamized and made sixty feet wide from this town to the St. Louis city line.

Butler, Pa.—This borough has voted to increase the debt for various public improvements, which includes more street paving, sewers for the public streets and an electric light plant.

Hartford, Conn.—About 1,200 feet of Garden street will be macadamized. The citizens on S. Main street have asked that the sheet asphalt pavement be continued to the South Green as soon as possible.

Allegheny, Pa.—Resolutions have been introduced in councils for grading and paving Ridgewood avenue, repaving Irwin avenue, repairing and regrading Sedgewick street, grading and paving Cuchert alley.

Davenport, Ia.—The paving committee of the city council has decided upon fourteen blocks of street paving for 1897, in Locust, Fifteenth, LeClaire and Main streets and Third avenue. The improvement of county roads is also advocated.

Peoria, Ill.—It is probable that the asphalt paving in Perry avenue will be continued from Cornhill street out to the city limits, making a continuous asphalt pavement from Main street to the main entrance of Glen Oak Park.

Milwaukee, Wis.—The board of public works has recommended that Grand avenue from Washington to Western avenue be paved with asphalt. Galena, from Fourth to Seventh street, with brick, Lisbon avenue, Center and Hadley streets with crushed stone and gravel; also stone curbing for seven streets.

Boston, Mass.—The estimated cost of the proposed asphalt paving in three streets, granite paving in one street and macadamizing three streets is $150,000. An ordinance has been introduced authorizing an appropriation of $200,000 for reconstructing Alford street, Charleston, between Main street and the Everett line.

Philadelphia, Pa.—A bill authorizing a loan of $2,000,000 has been offered to be used in repaving with improved materials streets of 40 feet or less in width. City Solicitor Kinsey holds that it is "clearly the duty of the Union Passenger Railway Company, or its operative lessee, to repair or repave streets when and as directed by the city."

Grand Rapids, Mich.—The estimates for the various kinds of material for improving Oakes street, from Sheldon street to Jefferson avenue, are as follows: Macadam and brick gutters, $3,332; cedar blocks on concrete, $4,234.50; cedar blocks and brick gutters, $4,392; asphalt and brick gutters, $5,494.50; asphalt entire, $5,742; asphalt and artificial stone curb and gutters combined, $5,817.

Kearney, N. J.—Resolutions were adopted Feb. 9 by the Kearney Township Committee that the Legislature be requested to pass an act, to be known as the Good Roads act, which will give the committee the power to issue $150,000 worth of bonds, not more than $30,000 to be issued in one year, the rate of interest to be not more than 5 per cent., and the bonds to run from ten to thirty years.

Atlanta, Ga.—A resolution has been introduced by Alderman I. S. Mitchell, Chairman of the Council Street Committee, which provides that the city shall advertise for bids from the makers of all kinds of paving materials. If adopted, it will result in a complete revolution of the street paving methods in this city, as it has not been customary heretofore to invite competition. About four blocks of asphalt paving is contemplated for Washington street this year.

Boston, Mass.—The Committee on Finance has been requested to provide in the next loan the amounts specified in the following list of streets: Copley square and streets bounding, asphalt paving on concrete and regulating, $37,000; Boylston street, from Charles street across Clarendon street, asphalt paving, etc., $42,300; Columbus avenue, from Boylston street to Boston & Albany railroad bridge, asphalt paving, etc., $43,900; Berwick park, from Columbus avenue to Providence division of New York, New Haven & Hartford railroad, macadamizing and regulating, $4,500; Cortes street, Berkeley street to Ferdinand street, $3,000; Isabelle street, from Columbus avenue to Ferdinand street, macadamizing and regulating, $2,900.

New York, N. Y.—Application has been made to the Legislature for the privilege of issuing city bonds to the amount of $2,000,000 for the special purpose of repaving streets in which the tracks of the Metropolitan Traction company and the Third Avenue Railroad Company are laid, provided these companies go ahead with the work of laying new rails. The city officials' idea is to put down the pavements at the time the rails are changed, for in that case one-third of the cost of repairing will be charged to the companies. If the work is done, asphalt pavements will be laid on Eighth and Sixth avenues, Church street, Madison avenue and probably in Center street. Improvements are also being planned in the northerly portion of the city.

Indianapolis, Ind. — Resolutions were adopted, Feb. 19, by the Board of Public Works for street improvements for 1897 as follows: Asphalt—Market street, 35 feet wide, New York street, 30 feet wide and Ohio street 32 feet wide, from East to Noble streets; New Jersey street, from Thirteenth to Sixteenth street, 24 feet wide, and from Sixteenth and Nineteenth streets 30 feet wide; Walnut street, from Pennsylvania street to Ft. Wayne avenue, and from Delaware street to Massachusetts avenue, 24 feet wide; Morris street, from East street to Madison avenue, 24 feet wide. Brick—First alley east of Alabama street; Hudson street, from Vermont to North; first alley north of New York; first alley north of North street, first alley east of Illinois, first alley east of Delaware street, first alley north of Hillside avenue. Gravel—First

alley north of Washington street. Declaratory resolutions were considered, Feb. 24, for asphalt paving and cement sidewalks.

CONTRACTS TO BE LET.

Toledo, O.—Bids will be received until March 17 for the Bancroft street stone road improvement. County Commissioners.

Shreveport, La.—Bids are asked until April 15 for 129,990 square yards of brick paving on concrete base; bond $1,000. N. B. Murff, Controller.

Lafayette, Ind.—Sealed proposals will be received until March 8 for the improvement of portions of Holloway and Fifth streets. Thomas W. Burt, City Clerk.

Flushing, N. Y.—Bids will be received until March 2 for macadamizing approximately 170,000 square yards of roadway; certified check, $1,000. G. A. Boullier, engineer.

East Cleveland, O.—Sealed proposals will be received until March 27 for paving Euclid avenue, from the eastern to the western limits of the village, with paving brick; bond, $5,000. H. B. Chapman, Village Clerk.

Newark, N. J.—Sealed proposals will be received until March 8 for grading and paving with Telford pavement, Mount Pleasant avenue, 7,500 feet and one mile of the Little Falls road; bond, $1,000. Thomas McGowan, Director Board Chosen Freeholders.

Decatur, Ind.—Sealed bids will be received until March 4 for the construction of a gravel or macadamized road, known as the David Steele road. Bonds in twice the sum of the bids must accompany the bids. Noah Mangold, County Auditor.

Bellefontaine, O.—(Special.)—Sealed proposals will be received until March 9 for macadamizing about 2,000 feet of Detroit street, and constructing curbs, gutters and crosswalks of sandstone or cement, tile drains, sewers, and sewer inlets; certified check, $300. W. C. Zearing, City Clerk.

Cleveland, O.—Sealed proposals will be received until March 2 for grading, draining, curbing and paving with asphalt and Medina block, Scranton and Central avenues and Center street and Monumental court. Also, paving with brick, State, Ward, York and Carroll streets, Clark avenue and Woodland court. D. E. Wright, Director Public Works.

SEWERS.

Youngstown, O.—Dr. Probst of the State Board of Health condemns the practice of this city, Niles, Warren and other towns on the Mahoning of emptying its sewerage into the river, and recommends that some radical improvements be made in the local sewerage system.

Boston, Mass.—Senator Roberts of Suffolk made an attack on the Metropolitan Sewer Commission in a bill asking that three commissioners be replaced by one discreet man who shall reside in the North, Charles River, or Neponset Valley district, and who shall be vested with the authority now given the Metropolitan Commission. The salary of the Commissioner shall be $3,000. Senator Roberts claims that the work is now so far advanced that one commissioner can attend to it.

CONTEMPLATED WORK.

Atlanta, Ga.—Ordinances have been approved or sewers in ten streets.

Syracuse, N. Y.—Considerable sewer construction is contemplated for this year.

Northeast Harbor, Me.—Plans will be submitted March 1 for a main sewer.

Albion, N. Y.—The question of a sewerage system and filter bed will be voted on.

Ravenna, O.—The City Council has decided to not build a sewerage system at this time.

Marion, Ind.—A main trunk sewer, about one mile long, is contemplated. L. A. Von Behren, Mayor.

LaPorte, Ind.—About 1,600 or 1,800 feet of sewers will be constructed this year. Hiram Burner.

Pana, Ill.—About 4,000 feet of twenty and twenty-four-inch sewer mains and two miles of laterals is contemplated.

Mt. Vernon, N. Y.—The Common Council is considering the best plan for disposing of its sewage.

Johnstown, N. Y.—A sewerage system, with filter beds, is being considered. James W. Miller, City Engineer.

Crawfordsville, Ind.—The question of constructing a sewerage system has been abandoned for the present.

Scranton, Pa.—An ordinance has been passed for sewers in the Eleventh, Twelfth and Nineteenth wards.

Londonderry, N. H.—The West Derry Sewerage Association has been incorporated to build a sewerage system.

The question of constructing sewerage systems will be voted on at Hollister, Mich., March 22, and at Newport, Me.

Chicago, Ill.—The sanitary board decided Feb. 17 to advertise for new bids for the completion of section 3 of the drainage canal.

Pittsburg, Pa.—Ordinances were affirmatively acted upon, Feb. 4, for the construction of sewers on a number of streets.

Washington, D. C.—The District Commissioners have ordered 775 feet of sewer in Hartford street, and 419 feet in Twelfth street.

Lyons, N. Y.—Plans and specifications for a complete sewerage system will be submitted to the taxpayers about April 1.

Delaware, O.—The question of constructing a sewerage system is receiving consideration. L. B. Dennison, Engineer Board of Commissioners.

Cohoes, N. Y.—Edward Hayes, Engineer for Public Improvement Commission, has completed plans for a sewer system for this city.

Laurium, Mich.—A bill was passed in the house, Feb. 17, authorizing this village to issue $35,000 in bonds to construct a sewerage system.

Mankato, Minn.—The residents of Minnesota street, Cummings' addition, have presented a petition to Council for a culvert over Warren's creek.

Kansas City, Mo.—The sewerage system is to be extended into the district bounded by Walrond avenue, Bales avenue and Ninth and Fifteenth streets.

Sewerage systems are contemplated at the following places: St. Elmo, Tenn.; Watertown, S. D.; Northampton, Mass.; Salinas, Cal.; Havana, Ill.

St. Louis, Mo.—An appropriation of $26,000 has been authorized to establish and provide for the construction of sewers in Hodiamont Sewer District, No. 1.

Cleveland, O.—An ordinance was passed Feb. 1 to issue bonds in the sum of $113,000 to pay part of the cost of constructing a main sewer in Walworth street.

Evansville, Ind.—The joint committees of the Indiana legislature visited this city Feb. 5 to investigate the sewerage of the hospital for the insane.

Plymouth, Ind.—Press reports states that, owing to difficulty with this city regarding sewerage, the Heinz Pickle Company contemplates establishing their plant elsewhere.

Emeryville, Cal.—The Town Trustees have been asked, by the citizens, to cause an examination, map and estimate of cost of construction to be made by the Town Engineer, for an adequate sewerage system.

Washington, Ind.—A sanitary sewerage system is contemplated. Messrs. Jepson, W. Q. William, Kocher, Kelle and Candler have been appointed a committee to investigate the matter.

Paducah, Ky.—J. H. Elliot, Sanitary Engineer of Memphis, Tenn., has districted this city for a sewerage system and the system he recommends will cover seven-eighths of the city; estimated cost, $63,000.

Canton, O.—(Special.)—Louis J. Riegler says that the Council adopted the report of the special committee for constructing sanitary sewers in the parts of Tenth, Seventh, Court and E. Lake streets that are not sewered.

West Orange, N. Y.—The advisability of co-operating with the South Orange and Irvington authorities in building an outlet sewer to tidewater in Newark Bay was considered at a meeting of the West Orange Township Committee Feb. 16.

Bowling Green, O.—The Committee on Sewers and Drains reported Feb. 15 that a new and more complete sewage system is needed and recommends that preliminary steps be taken at once, and that a competent engineer be employed to make plans, profiles, etc. Mayor Graham.

CONTRACTS TO BE LET.

Winona, Minn.—The council will be ready to award contracts for a sewerage system about March 20.

Grenada, Miss.—Bids are invited until March 11 for constructing a sewerage system. W. F. Hallam, Clerk.

Bellefontaine, O.—Sealed proposals will be received until March 9 for constructing tile drains, sewers and sewer inlets. W. C. Zearing, City Clerk.

CONTRACTS AWARDED.

Sharpsburg, Pa.—The contract for building sewers was awarded, Jan. 30, to J. B. Sheets of East Pittsburg for $7,637.

Buffalo, N. Y.—F. A. Goth was the lowest bidder, Feb. 18, for the construction of the Delaven avenue sewer at $6,995.

New York, N. Y.—Patrick Casey secured the contract for constructing sewers in Casey and other streets for $64,032.

St. Louis, Mo.—The contract for constructing the Potomac street sewer, No. 8, was awarded, Feb. 16, to James Martin for $3,346.74.

Los Angeles, Cal.—C. C. Merrill of this city secured a contract for laying the sewer pipe in the City of Mexico, which involves an expenditure of more than $3,000,000 and will require eight years to complete.

Racine, Wis.—The lowest bids received for constructing sewers in Hamilton street was that of Rassmussen, Anderson & Co., for $8,095.45.

Houston, Tex.—Bids were received, Feb. 8, for constructing a sewer in Hogan street as follows: A. F. Lucas, $2,264; R. C. Storris, $2,618; W. E. Humphreyville, $2,414.

Albany, N. Y.—The contract for laying a sewer in Elm and Grand streets, from Delaware to Madison avenues, was awarded, Feb. 1, to John Doyle for $6,640.83.

Niagara Falls, N. Y.—The contract for constructing sewers No. 67 and 68 was awarded Feb. 5, to Makin & Cookman of this city for $4,947 and $2,137, respectively.

Newark, N. J.—Bids were received, Feb. 12, for constructing a 7x4 6-inch brick sewer on New Jersey Railroad avenue, between Emmett and Wright streets. The contract was awarded, Feb. 19, to Ralph Satchwell for $1,954.55.

Quincy, Mass.—The contract for cast iron sewer pipe was awarded, Feb. 2, to M. J. Drummond & Co. of New York at $20.30 per ton for straight pipe, $47 per ton for curved pipe and $44 per ton for special castings.

Rochester, N. Y.—Bids were received, Feb. 16, for the pipe sewer in East avenue and Upton Park as follows: Charles B. Wagoner, $3,415; Lauer & Hagaman, $3,704; William H. Jones & Sons, $4,145; Whitmore, Rauber & Vicinus, $4,241. The contracts have not yet been awarded.

Toledo, O.—The lowest bid received, Feb. 8, for the sub-main sewer in Jefferson street, from Huron to the river, 1,320 feet, was presented by W. J. McMahon at $4.27 a foot, including manholes and masonry; total, $5,920.40. W. J. McMahon's bid was the lowest also for a sewer in the alley between Oak and Clark street, 868 feet long, at $1.12 a foot, or $1,029.16.

Erie, Pa.—The contract for building a 15-inch sewer in Holland street and a 12-inch sewer in Twenty-seventh street was awarded, Feb. 4, to F. J. Eichenlaub as follows: Fifteen-inch straight, curved and branch pipe, $1; 9-inch pipe, 30 cents; 6-inch pipe, 25 cents; manholes, $30. For the 12-inch sewer the same bid was made except on the straight, curved and branch pipe, which will be put in for 75 cents.

Toledo, O.—Contracts for six new sewers were awarded, Feb. 4, the largest of which were Fifth street, from Nevada to Starr, H. P. Streicher, $1,472.09; Maplewood, from Georgia avenue to Castele boulevard, F. E. Cole, $1,707.60.

WATER-WORKS.

State Engineer Adams in his report to both branches of the New York legislature calls particular attention to the fact that the water supply of Brooklyn now uses the entire source of supply in Long Island and that New York must go beyond the Croton water-shed for its supply, making necessary the development of the upper Hudson water-shed and the storage of its waters at the earliest possible time. The report is considered a most important one.

CONTRACTS TO BE LET.

Grenada, Miss.—Bids are asked until March 11 for constructing water works. W. F. Hallam.

Adams, Minn.—Sealed proposals will be received until March 2 for a water works system. G. W. Dahlquist, Village Recorder.

Norwood, O.—Bids will be received until March 6 for improvements to the water works pumping plant. Harry Rikhoff, Chairman Board of Trustees.

Newberry, S. C.—Bids are asked until March 8 for constructing a water works and electric light plant. James McIntosh, Chairman Water Commissioners.

Caledonia, N. Y.—Bids are asked until March 9, postponed from Feb. 25, for constructing a system of water works; certified check 2 per cent. J. A. Wilson, Secretary Board Water Commissioners.

Lafayette, Ind.—Sealed proposals will be received until March 22 for a vertical high duty compound condensed pumping engine of 6,000,000 gallons capacity in twenty-four hours. Edward Cunningham, Superintendent Water Works.

Alton, Ill.—Sealed proposals will be received March 15 for furnishing the water supply for both fire protection and domestic purposes; original capacity of pumps shall be 10,000,000 gallons in twenty-four hours, or two pumps of 5,000,000 gallons capacity each; settling basins shall be constructed and maintained, and if they fail to keep the water clean a filtering system shall be used. Henry Brueggeman, Mayor.

CONTEMPLATED WORK.

Pine Ridge Agency, S. D.—The water works and sewerage systems for the agency will be readvertised.

Buffalo, N. Y.—The commissioners of public works will ask for a new 30,000,000-gallon pumping engine.

Trenton, Tenn.—The legislature has been petitioned for authority to issue $25,000 in bonds for water works.

Sulphur Springs, Tex.—This town contemplates purchasing a 500,000-gallon pump soon. C. J. Storer, Superintendent.

Washington, D. C.—The estimated cost of increasing the water supply of the District of Columbia is $831,276.30.

Washington, La.—Plans have been submitted for water works and the contract will probably be let during March.

Detroit, Mich.—An auxiliary pumping station at the municipal lighting plant is favorably considered by the commission.

Toledo, O.—It is stated that the question of a pure water supply must confront the board of trustees very shortly.

Westpoint, Miss.—Walter G. Kirkpatrick, Civil Engineer, of Nashville, Tenn., will superintend the construction of water works for this town.

Pittsfield, Ill.—Plans and specifications for improving the water works will be ready about June 1. C. E. Strong, Superintendent.

Russellville, Ky.—A stock company will probably be organized within a very short time to build water works. Capt. J. M. Dale is interested.

The water works proposition has been favorably voted on at the following places: Richmond, Mo.; Ligonier, Pa.; Florence, Col.; Flagstaff, Ariz.

Merrimac, Mass.—A favorable report has been submitted for water works to cost from $60,000 to $90,000. F. L. Parker, Bailey Sargent and S. A. McConnell, Committee.

Lockport, N. Y.—The committee on water supply asks for further time, in order that H. G. Cook of St. Louis, an expert on water supply, may make a thorough examination.

Water mains extensions are contemplated at the following places: Jackson, Mich.; Northfield, Minn.; Columbus, O.; Squirrel Island, Me.; Nutley, N. J.; Glenville, O.; Ottumwa, Ia.

Water works bonds will be voted on as follows: McMinnville, Tenn., March 15; Perham, Minn.; Hancock, Mich.; Ontario, Cal.; Verdi, Cal.; New Denver, B. C.; Ellisville, Miss., March 1.

Medway, Mass.—A charter for water works is desired. The Medway Water Co. wishes to sell its plant to the town. H. S. Partridge, W. A. Fales and M. F. Desmond, Legislative Committee.

Watervliet, N. Y.—A bill has been introduced by Senator Nussbaum extending one year the time allowed the water board of this place to report on the expense and feasibility of a water system.

The construction of water works systems is contemplated at the following places: Osceola, Ia.; Chelan, Wash.; Deep River, Ia.; Virden, Ill.; Williamstown, N. J.; Gagetown, Mich.; Varna, Ill.; Chesterton, Ind.; Williamsport, Ind.; Two Rivers, Wis.; Astoria, Ill.; Vinalhaven, Me.; Lewes, Del.; Graham, Va.; Elizabeth City, N. C.; Uniontown, Ky.; Mt. Vernon, Me.; Lockhart, Tex.; Jackson, Ga.

Philadelphia, Pa.—An ordinance was introduced in Select Council, Feb. 4, providing for the construction and maintenance of a water supply system by the Schuylkill Valley Water Co., which will erect a first-class plant with two filter beds and supply this city with water for a period of fifty years, in consideration of an annual payment of $900,000, the entire plant and property to go to the city without cost at the end of fifty years.

Lebanon, Pa. — (Special.) — George W. Hayes, City Engineer, says that the City Council has directed the Board of Water and Lighting Commissioners to ask for plans and specifications from contractors to furnish Lebanon with a guaranteed water supply from wells in the neighborhood of the present wells, amounting to not less than 1,000,000 gallons per day, the contractor to furnish wells and everything, and guarantee the supply, under bonds, for a period of five years.

CONTRACTS AWARDED.

Glencoe, Minn.—The contract for water works was awarded to Fairbanks & Morse for $25,600.

Westport, Mo.—The contract for laying pipes and water mains was awarded to Adam J. Armstrong Feb. 17.

Albany, N. Y.—R. D. Wood & Co. of Philadelphia, Pa., secured the contract for furnishing cast iron pipe for the Water Board.

North Tonawanda, N. Y.—The Holly Manufacturing Company secured the contract for building a 6,000,000-gallon pumping engine for North Tonawanda for $14,837.

BRIDGES.

Le Roy, N. Y.—A new highway bridge is being agitated to cross the Oatka river and connect Church and Lake streets.

Somerville, Mass.—An iron bridge is proposed at Kent street, estimated cost, $20,000.

Kansas City, Mo.—A Melan arch bridge will be erected over Anderson avenue at Independence Boulevard.

Climax, Mich.—Profiles for a bridge over Red river will be made by Simon Klovdal of Crookston.

Rockingham, N. C.—The construction of several iron and steel bridges will be voted on.

Buffalo, N. Y.—Bids will be received March 2 for the superstructure of the Smith and Seneca streets viaduct.

Utica, Mo.—A bridge across the west fork of the Grand river is contemplated; estimated cost, $4,000.

Iowa City, Ia.—Bids will be received until April 9 for bridge work for this year. County Auditor.

Canal Dover, O.—A steel bridge over the Tuscarawas river, between this city and New Philadelphia, is contemplated.

Greenwood, Miss.—The board of supervisors has authorized the issue of $22,000 bonds for a bridge over the Yazoo river.

Harrisburg, Pa.—The court of Dauphin county has been petitioned for a bridge over Lynch's Run, in Londonderry township.

Fulton, N. Y.—A steel girder bridge, is proposed to replace the present one over the Oswego canal at First and Oneida streets.

New York, N. Y.—A bill was introduced Feb. 12 providing for two iron, stone or steel bridges across the Bronx river.

Muscatine, Ia.—The Board of Supervisors will let a contract for a new bridge across Cedar river at Tice's Ferry, in April.

Worcester, Mass.—A new iron and steel bridge has been ordered built at the Boston & Albany Railway crossing near Warren, Mass.

Rawlins, Wyo.—The county commissioners contemplate asking for bids soon for a bridge over Encampment creek, near Perryam Ranch.

Mt. Vernon, N. Y.—Immediate action is urged concerning the proposed bridge across the Hutchinson river canal, at Fulton avenue.

Maysville, Ky.—(Special.)—W. C. Pelham, City Engineer, says the contract will be let March 6 for a 160-foot span steel bridge. County Turnpike Commissioners.

St. Paul, Minn.—The Board of Public Works has decided on plans for a 36-foot bridge over the tracks at Raymond avenue. Estimated cost, $38,000.

Nebraska City, Neb.—Bids are asked until March 4 for constructing all bridges that may be ordered during the year. Bond, $4,000. E. R. Haas, County Clerk.

Boston, Mass.—The question of rebuilding the West Boston bridge, at an estimated cost of $1,000,000, is being agitated. William Jackson, City Engineer.

Worthington, Minn.—Sealed proposals will be received until March 2 for the construction of the superstructure of a steel bridge. Edgar A. Tripp, County Auditor.

Grand Rapids, Mich.—The Committee on Bridges of the Common Council will recommend that a bridge be constructed across Grand river, from Butterworth avenue.

Lecompton, Kas.—A bill authorizing Douglas and Jefferson counties to issue bonds for building a bridge across the Kaw river has been passed. Estimated cost, $7,000.

Marshall, N. C.—The County Commissioners have been authorized by the General Assembly to levy a special tax to build an iron and steel bridge over the river near this place.

Syracuse, N. Y.—City Engineer Stuart recommends the construction of a new steel girder bridge over Onondaga creek in W. Water street. The bill for a bridge to replace the swing bridge in Salina streets has been favorably reported in the Assembly.

St. Paul, Minn.—Bills have been introduced in the Legislature appropriating money for bridges as follows: Five hundred dollars for a bridge across Otter creek in McLeod county; funds to build a bridge across Buffalo creek, McLeod county; $800 for a bridge across Swan river, McLeod county; $1,000 for a bridge in Douglass county; $1,500 for one in Swift county; $2,000 for one across Beaver creek, Murray county; $700 for one across Watonwan river, Cottonwood county; $300 for one across Spunk river, Stearns county; $1,000 for one across the Clearwater in Red Lake county; $6,000 for a free wagon bridge across the Red river in Norman county; $1,000 for a bridge over Crow Wing river, Crow Wing county; $2,000 for a bridge on the Gull lake thoroughfare in Crow Wing county, and $600 for a bridge in Mower county.

PARKS.

Indianapolis, Ind.—An appropriation of $350,000 for parks is now regarded as sure to be made by the council.

Chicago, Ill.—The South Park Commissioners will probably issue $3,000,000 in bonds for developing the Lake Front park.

Newport, R. I.—Olmstead & Elliott of Brookline, Mass., have submitted plans made by them for the proposed esplanade in this city.

Newark, N. J.—A report has been made by John Bogart and Nathan F. Barrett, the Essex County Park Commissioner's landscape architects and engineers, outlining a system of parks and parkways.

Rockville, Ind.—John L. Noel has donated to this town over six acres of ground to be used as a public park, which has been named Noel's Park by the council. Park commissioners have been appointed.

Terre Haute, Ind.—The gift of Mrs. Deming of a park on the hills east of this city depends upon the opening of Ohio street through the E. & T. H. railroad yards. Mayor Ross and the councilmen have been very successful so far in their efforts to proceed in the matter.

Philadelphia, Pa.—(Special.)—Chief Engineer Russell Thayer has reported to the committee on plans and improvements of the Fairmount park commission improvements amounting to $181,065, the items of which are as follows: $5,000 around the Washington monument at Green street; $67,000 for grounds south of Girard avenue west of the Zoo, $12,000 being for bicycle paths; $57,000 for tree planting and sodding in various parts of the park; $11,000 for asphalt around the parade grounds and the park at Dauphin street entrance; $5,700 at Fifty-second street entrance; $33,000 for inclosed bicycle paths along both sides of Belmont avenue. As there is only $100,000 available for improvements the committee recommended the park at Green street entrance and on the grounds west of the Zoo.